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THE

KANSAS UNIVERSITY

SCIENCE BULLETIN.

DEVOTED TO THE PUBLICATION OF THE RESULTS OF RESEARCH
BY MEMBERS OF THE UNIVERSITY OF KANSAS.

VOL. III.

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KANSAS.
1906.

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ERRATA TO ARTICLE No. 5.

Page 132, fourth line from the bottom, and page 135, line 7, "Signoret (1868)" should read "Signoret (1869)".

Page 133, line 10, "granulated" should read "crenulated."

Page 137, line 14, "*Northopegia*" should read "*Nothpegia.*"

The explanations to plate XXV should read as follows:

"FIG. 1. *Parlatoria proteus crotonis* Ckll."
"FIG. 2. *Parlatoria cingala* Green."

The explanations to plate XXVIII should read as follows:

"FIG. 1. *Parlatoria proteus pergandei* Comst."
"FIG. 2. *Parlatoria proteus* Curt."

The following changes should be made in plate references wherever they occur in the text:

"Plate XXV, fig. 1," should read "Plate XXVIII, fig. 2."
"Plate XXV, fig. 2," should read "Plate XXVIII, fig. 1."
"Plate XXVIII, fig. 1," should read "Plate XXV, fig. 1."
"Plate XXVIII, fig. 2," should read "Plate XXV, fig. 2."

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VOL. VI. No. 2.

BULLETIN
OF THE
UNIVERSITY OF KANSAS.

PUBLISHED BIMONTHLY BY THE UNIVERSITY OF KANSAS,
AT LAWRENCE.

SCIENCE BULLETIN,
Vol. III, Nos. 1, 2, 3, 4, 5, and 6.

(Continuation of Kansas University Quarterly.)

OCTOBER 1905.

LAWRENCE, KANSAS.
Entered at the Post-office as Second-class Matter.

NOTICE TO EXCHANGES.

The attention of learned societies and other institutions which exchange scientific publications with the University of Kansas is called to the list of publications of this University on the third page of the cover of this issue.

Those marked "Supply exhausted" cannot be furnished at all; those marked "Supply small" cannot be furnished separately; those marked "Supply large" will gladly be furnished to any of our exchanges who may need them to complete their files.

Back numbers of the *Kansas University Quarterly* and *Geological Survey*, as far as possible, will be sent to those of our newer correspondents who are able and willing to reciprocate.

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THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. III, No. 1—July, 1904.
(Whole Series, Vol. XIII, No. 1.)

CONTENTS:

KANSAS APHIDIDÆ, WITH CATALOGUE OF NORTH AMERICAN ALPHIDIDÆ, AND WITH HOST-PLANT AND PLANT-HOST LIST, *Charles Emerson Sanborn.*

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KAN.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 1. JULY, 1904. { WHOLE SERIES, VOL. XIII, No. 1.

KANSAS APHIDIDÆ.

WITH CATALOGUE OF NORTH AMERICAN APHIDIDÆ AND HOST-PLANT AND PLANT-HOST LIST.

With plates I to XXII.

BY CHARLES EMERSON SANBORN.

PREFACE.

IN securing material for ontogenetic study, I became impressed with the number of species of Aphididæ existing in Kansas. Accordingly, in the following pages appears the first part of the taxonomic discussion. It is the intention to complete this phase of the subject as soon as some other forms can be obtained.

The species discussed, whether new or old, have been described, in order to make them more easily recognized and understood by those interested but who have no access to literature. In doing this, not only have careful measurements been made with the eyepiece micrometer, but an illustration is presented with each specimen described, in order to emphasize characteristics not easily conveyed in words.

Yet however accurate some characteristics may be given they cannot always be depended upon. For instance, in coloration, variance of color depends not only upon age but also upon the season of the year. The same color may not prevail throughout the growth of an individual. The color present is not always constant in a species, because a change of temperature or a change of food-plant often gives a different tinge to the general color. Therefore, having these things to deal with, it has been very difficult to decide definitely in many cases the specific location of forms found.

In conclusion, the author thanks Prof. S. J. Hunter, the head of this department, under whose advice and guidance this work has been done. Expressions of appreciation are also due Miss Marguerite Wise and Miss Miriam Palmer, of this department, for assistance in the preparation of illustrations. Following their names are the figures drawn by each. Other figures contained were drawn by the author.

Miss Wise: 1 to 27, inclusive, 30, 34, 35, 36, 39, 48, 49, 50, 53, 62, 64, 66, 67, 68, 69, 70, 71, 72, 74, 75, 76, 83, 84, 85, 89, 93, 94, 95, 100.

Miss Palmer: 28, 37, 45, 56, 57, 59, 60, 61, 77, 78, 81, 86, 87, 88, 91, 96, 97, 98, 99, 101.

INTRODUCTION.

Plant-lice or aphids belong to the family Aphididæ and to the suborder Homoptera in the order Hemiptera. They are characterized as small, soft-bodied insects which receive their nourishment in the form of liquid taken into their bodies by means of setæ which lie in a jointed beak. The distal end of the latter is placed closely to the cellular tissue of the plant and used as a guide by means of which the four small, bristle-like setæ are extruded into the live tissues of the plant, from which the juicy nourishment is conveyed to the assimilative organs of the insect. They have six legs, and they may have a pair of compound eyes, three ocelli, two pairs of wings, a pair of honey-tubes, a beak, and a style, but these parts are not constant throughout the family.

The Head.

The first main division of the insect's body bears some very important organs of classification. It always bears a pair of antennæ, one on each side of the dorsocephalic angle of the head. Caudad of these are usually two large compound eyes, which at their caudal margins have a few facets extending beyond the rest. These are called occular tubercles. Between the eyes and antennæ and a little mesad are two simple eyes or ocelli; also between the antennæ and a little ventrad on the front is another ocellus. On the ventral surface of the head the beak or labium is attached. This is mainly characteristic by its length, but does not afford such remarkable characteristics as the antennæ.

From a specific standpoint the latter appendages may be used with more value than any other feature, and in regard to which the following must be taken into consideration: The number of segments,[1] the total length, the length and color of each segment, the number and shape of the sensoria on each segment, and the union with the head. This union is carefully shown in each species illustrated, and also an enlarged figure of the third segment, showing approximately the kind and number of sensoria.

Another characteristic to be mentioned in connection with the head is the labium. (Plate I, fig. 1.) This is a greatly enlarged mouth-part, which in some specimens is larger than any other appendage. It has three or four segments, and in its normal position lies on the ventral surface of the body between the legs, as shown in plate IV, figure 25. On the ventral side of this is a canal, a cross-section of which is shown in figure 5. In this groove lie the mandibular and maxillary setæ, a cross-section of which is shown in figure 6.

The setæ are all separate at their proximal ends, but in the chitinous fold (fig. 3), which may be called the antelabial sclerite, they are all approximated. The maxillary setæ are quite firmly locked with their concave sides opposite to each other, thus forming a tube, a cross-section of which is shown, taken from the first segment. (Plate I, fig. 6, *A*.) These lie on the median chitinized ridge on the floor of the canal, for which see figures 3 and 6. On each side of this ridge is a similar chitinized line on which lie the mandibular setæ. (Fig. 3.) When the floor is narrowed, as is done in feeding, the latter chitinized areas are turned ventral side toward each other, thus appressing the mandibular setæ with their concave sides opposite, forming a tube in which are the maxillary setæ.[2] Thus each pair has a guide, in which they may slide lengthwise, and drill into the tissues of the plant, from which the sap is conveyed to the assimilative organs of the insect through the tube formed by the concavity of the maxillary setæ.[3]

---

[1] The distal segment is not counted as such unless equal to or longer than the penultimate. Exceptions, however, are cited.

[2] For treatise on the homopterous mouth-parts, see Walter J. Meek, K. U. Sci. Bull., vol. XII, No. 9, 1903.

[3] Or, in other words, the labium ensheaths the mandibles, which in turn, by their concave interior surfaces, encompass and hold in position the maxillæ.

In connection with the labium may be mentioned the labrum (plate I, figs. 1 and 4), which is also prolonged distally into a sharp point. Its lateral edges are turned under so that they approximate on a median ventral line, which is chitinized. At the proximal end the folds diverge. This forms a sort of guide directly ventrad the antelabial sclerite, while the distal end of the labial sclerite extends a little beyond or caudad of this. The need of these two sclerites may be clearly understood when the motion of the labium is considered. For instance, suppose the insect to be in a feeding position. The setæ then are all straight, but when the insect removes the labium to its venter again, after feeding, it will then be at right angles to its former position, and the wire-like setæ will have been drawn nearly at a right angle over the antelabial sclerite. Again, when the labium is brought into a feeding position, the canal being shortened, will cause the setæ to be bent outward, but the labial sclerite helps to hold them in the canal, the latter being almost eliminated at this point on account of the bend. Therefore, on account of the motion of the labium and of the absence of the canal at this point, this need of special devices for holding the setæ may be seen.

The Abdomen.

The third division of the body is the abdomen. Its shape depends largely upon its distension. Since the latter varies with age or on account of food material, it is hardly necessary to formulate any characteristic basis upon its size. Its color and appendages, however, are of importance. And, in addition, there is present in some forms an external covering of pulverulent or cottony material. By the appendages are meant the honey-tubes[4] and the style. And although tubercles may be present, they are not considered as the former.

The honey-tubes are external openings on the dorsal side of the sixth segment. These are of various sizes and shapes. The four principal types may be defined as cylindrical, incrassate, clavate, and tuberculate. The first type is the most common, but it is seldom perfect. For instance, a honey-tube of two millimeters in length may be a shade narrower or broader in some part of its length and yet be defined as cylindrical.

---

[4] The exact function of these organs has never been scientifically determined, but it has been lately conceded that they are purely excretional, and not "secretional." Other names used to denote these are horns, cornicles, nectaries, and siphuncles.

The second type or incrassate form is used to describe when the tube is distinctly enlarged or diminished in size or breadth. This irregularity may occur any place on the tube, but when at the distal end it is called clavate, and when in form of a gradual distension, as shown in figure 12, it may be called vasiform. The last or tuberculate type may partake of the first two forms, but is never longer than broad. For illustrations of these types, see plate II.

The second type of appendage under consideration is the style. It is an outgrowth of the last segment of the body. Of this there are about three predominant types. (See plate [I.) The first may be defined as ensiform. This is predominant among the *Nectarophorini.* The caudal end usually tapers to a point, and is generally turned dorsad, causing the dorsal boundary line to become somewhat semicircular. The central part of the style may be its broadest division. The second or cone-shaped type is broadest at the base, from which it tapers to a point at the distal end. This form is common to the *Aphis.* The third type is known as globular. It may be constricted near the center, so that a knob is formed at the distal end. The knobbed is the larger form of this type. The other or subobsolete is similar in size and shape to the former, with the constriction and knob removed. The obsolete type of style is when the last segment is not lengthened by any projection. Such a form would be that shown in figure 26, plate IV.

The Thorax.

The second large division of the body is the thorax, which is similar to that of other insects. Consequently only the wings will be noted here as of special importance. It is from the venation of these that the subfamilies are mainly distinguished. When on foot most species carry their wings in a deflexed position; *i. e.*, the cephalic border or margin becomes the ventral margin and lies near the lateral margin of the body, and what is normally the caudal margin becomes the dorsal margin and approximates dorsad the abdomen. The cephalic pair of wings are much larger than the caudal pair, and in their color, venation and expansion depend specific characteristics. For illustration of terms used, see plates.

In the following descriptions of species the location and termination of the venation are not given, but are quite accurately shown in accompanying illustrations. The location of coloration is generally designated with stipplings. On the caudal margin of each large wing is a longitudinal fold by which the caudal wing is held in the same plane with the cephalic one by means of hooklets. This fold allows a sliding motion of the hooklets, which also allows the wings to be brought cephalad or caudad in the same plane, and at the same time firmly locked together. For further information concerning the wings, see descriptions opposite plate III.

Technique.

In the systematic study and collection of these insects the author at first took no single method, but after experimenting followed the ones herein mentioned as the most expedient and beneficial.

When collecting, bottles with large open mouths should be carried. Cotton is used instead of cork stoppers. When specimens are found, that part of the host-plant infested is detached and put into the bottles with the insects *in situ*. The insects will remain in a healthy condition when bottled in this manner to enable one to transfer them to the laboratory, where notes concerning their host-plant and also a brief description of them can be taken.

For the brief notes an especially prepared blank form is very convenient and expedient. It also serves as a guide which helps to insure against the omission of details. A type of this blank is shown under the head of "Color Key." This should be used for describing each fresh species, before it is treated with any chemical. A cover-glass will hold the specimen in position on the slide while the characters are noted by aid of a compound microscope.

After the specimen has been noted in the color key, some typical forms of it should be permanently mounted on a slide in balsam, and several specimens should be preserved in a vial of formalin of a five-per-cent. solution or alcohol of a seventy-per-cent. strength. The formalin is found to be superior in many respects to the alcohol.

In studying and classifying specimens, some typical forms may be removed and dehydrated with alcohol; only a few of the higher grades need be used. These may be siphoned off from the insects after periods of thirty minutes each respectively. Clearing mixture[5] is the next reagent added, in which the specimens may remain fifteen minutes. From this they are removed and arranged on slides with dissecting needles, and on them is dropped xylol balsam over which a cover-glass is placed, but not pressed. As soon as the balsam is dry the insects are sufficiently cleared for study. The measure key[6] is now used for completing the characteristics not found in the color key. When it is desired to recopy the descriptions the aphid theme may be followed. This insures an orderly arrangement and the omission of no characteristics.

The accompanying illustrations were drawn with the camera lucida in some instances from this kind of mount, but more often from fresh specimens mounted by aid of no chemical other than Canada balsam.

Color Key.

Underscore terms used. Blanks are to be used for qualifying terms and comments.

Locality ....

Acc. No. ....

Head—black, green, brown ....

Antennæ—concolorous ....

Eyes—black, red ....

Beak—concolorous ....

Prothorax—black, green, brown ....

Thorax—black, green, brown ....

Wings—deflexed, reposed ....

Wings—clouded, banded ....

Veins—black, brown ....

Date ....

Name ....

Stigma—black, gray, brown ....

Femora—black, green ....

Tibia—black, green ....

Tarsi—black ....

Abdomen—bare, pulverulent, cottony ....

Abdomen—green, black, brown ....

Abdomen—other markings ....

Honey-tubes—black, green, brown ....

Style—black, green, brown ....

Host-plant: Common name .... Genus .... Sp. ....

Parts affected—leaves, part, dorsal, ventral, marginal, petiole, twigs, fruit, distal, proximal, trunk, roots, gall, pseudogall ....

Habits—aerial, subterranean, sporadic, gregarious, viviparous, oviparous ....

Comments: ....

....

....

---

[5] Clearing mixture: Two parts by measure of carbolic acid crystals and three parts of rectified spirits of turpentine.

[6] The color key and measure key should be printed on the same folder, for the sake of convenience.

Measure Key.

Underscore terms used and fill out blanks.

Acc. No............ Name............................

- Head
  - Antennæ
    - Hirsute ....glabrous.......
    - Length
      - Apparent, mm. I..II..III..IV..V..VI..VII..
      - Real, mm. I..II..III..IV..V..VI..VII..
      - Total length
        - Apparent, mm... .....
        - Real, mm.......
      - Extends......................
    - Sensoria
      - Circular, transverse.
      - Number, III....IV....V....VI....
  - Eyes
    - Ocular tubercles......
    - Ocelli..........
  - Beak, length
    - Apparent, mm......
    - Real, mm......
- Prothoracic tubercles: Present, absent.
- Wings
  - Venation......
  - Stigma
    - Length
      - Apparent, mm......
      - Real, mm......
    - Breadth
      - Apparent, mm........
      - Real, mm.
  - Total expansion
    - Apparent, mm.......
    - Real, mm.......
- Legs
  - Normal.......
  - Length of metatarsus
    - Apparent, mm......
    - Real, mm......
- Tubercles.......
- Honey tubes
  - Cylindrical, incrassate, clavate, tuberculate.
  - Extent, base of style, distal end............
  - Length
    - Apparent, mm......
    - Real, mm......
- Style
  - Glabrous, hirsute................
  - Ensiform, conical, globular, subglobular, obsolete.
  - Length
    - Apparent, mm... ..
    - Real, mm......
- Total length of body
  - Apparent, mm......
  - Real, mm......
- Width of abdomen
  - Apparent, mm......
  - Real, mm......

Aphid Theme.

This key is followed when a final description is taken from the color and measure keys.

- Head
  - Color.
  - Antennæ
    - Color and covering.
    - Length of segments.
    - Total length.
    - Length in relation to the body.
    - Sensoria
      - Shape.
      - Number per segment.
  - Eyes
    - Color.
    - Ocular tubercles.
    - Ocelli.
  - Beak
    - Color.
    - Length.
    - Length in proportion to the body.

- Thorax
  - Prothorax
    - Color.
    - Lateral tubercles.
  - Mesa- and Metathorax
    - Color.
    - Wings
      - Color.
      - Venation
        - Color.
        - Normality.
      - Stigma
        - Length.
        - Breadth.
      - Total expansion.
    - Legs
      - Color.
      - Covering.
      - Normality.
- Abdomen
  - Color.
  - Tubercles.
  - Honey-tubes
    - Color.
    - Shape.
    - Length.
    - Length in relation to metatarsi.
    - Length in relation to the body.
  - Style
    - Color.
    - Covering.
    - Shape.
    - Length.
    - Length in proportion to honey-tubes.
  - Total length of body.
- Œcology
  - When found.
  - Host-plants
    - Number.
    - Position on.
  - Habitat.

The Wax Glands.

In aphids which secrete a waxy or woolly material there are certain glands in which the secretion is elaborated.

Some forms of plant-lice attract a great deal of attention on account of a flocculent material which seems to grow out from their bodies like the wool on sheep. Huber says that ants are known to keep a stock of "cows and goats." And his metaphor was not far-fetched, because from the habits of certain ants with aphids this statement is in one sense true. Although it is not known that the aphids use the "goats" as a commodity of any greater industry than they do the "cows." In fact, the wool does not seem to be of any particular use to them.

Is this wool an outgrowth of the epidermis? There seems to be only one brief answer on this point in former publications. And in this the author defines the secretion as being "forced through chitinous rims to cup-like glands, the glands arranged in clusters four to six or seven in a cluster, and each composed of numerous cells." From this it appears that the material does not grow out of the epidermis as hair or wool, but that there are certain glands which are situated near the epidermis that elaborate this so-called secretion.

Plate I, figure 1, is an illustration of an apterous, viviparous *Schizoneura lanigera*, which will serve to represent the location of one type of these glands. In this species they seem to be distributed in a uniform manner over the entire body. In appearance they resemble the blastula stage of an egg. (See fig. 1, *B*.) These glands are not composed of a uniform number of cells, but range in number up to twenty; and it is from these that the flocculent or woolly material comes.

Figure 2 is a gland of similar function which is found in *Pemphigus burrowi*. The material elaborated by this gland is more of a pulverulent nature than that secreted by *lanigera*. It also seems to be more impervious to water than the former. The glands are not as numerous in number, but they contain more cells than the other form.

In the first-mentioned type we find the production to be of a woolly or flocculent nature in appearance, but in composition it is more like asbestos, since it may be pulverized into a fine powder. In its normal state it acts as a protection against water, as also doubtless against extremes of weather, for this species is known to live in a temperature of 21 deg. F. Under favorable conditions this covering grows at the rate of eight millimeters or one-third of an inch per month, as was demonstrated recently in this laboratory.

Subfamilies of the Aphididæ.

1.	Winged form unknown; subterranean in habit	Rhizobiinæ.
	Winged form known; areal in habit	2.
2.	Antennæ three- to five jointed; fore wing with only two discoidals.	Chermaphinæ.
	Antennæ six- to seven-jointed; fore wing with three discoidals	3.
3.	The third discoidal simple	Pemphiginæ.
	The third discoidal branched	4.
4.	The discoidal with only one branch	Schizoneurinæ.
	The discoidal twice branched	5.
5.	Antennæ six-jointed	Lachninæ.
	Antennæ seven-jointed, rarely only six jointed	Aphidinæ.

Subfamily RHIZOBIINAE Passerini.

Antennæ five-jointed and short. Eyes small and inconspicuous, or none. Beak variable in length. Wings never acquired. Legs short and well developed. Tarsal claws not always distinctly separate, and sometimes only one is present, as in *Rhizobius*. Body somewhat short and somewhat convex dorsally.

It may be bare, hirsute, or tufted with setæ or flocculent material. Honey-tubes absent. Style absent or inconspicuous. These species are subterranean in habit and live on roots, and are found with ants.

Genus **Tychea** KOCH.[7]

Antennæ composed of five joints, almost equal in length, the third a little the longest. Eyes none or very rudimentary. Beak variable in length according to age, but rather long and thick. Not known to acquire wings. Legs short. Honey-tubes, none. Style almost obsolete or none.

Genus **Trama** HEYDEN.[7]

Antennæ about one-half the length of the body, six-jointed, including the unguis; third joint the longest, and equal to the fourth and fifth together; fifth and sixth joints equal. Eyes very small and almost obsolete. Beak about two-thirds the length of the body. Not positively known to acquire wings. Legs long, particularly the hind pair, which possesses only one tarsal joint, which is equal to the femur in length; the other tarsi are two-jointed. Honey-tubes and style inconspicuous.

Genus **Forda** HEYDEN.[8]

Antennæ five-jointed, the third joint the longest. Eyes very small. No winged forms known. Abdomen convex. Honey-tubes absent. This genus has eyes and antennæ more simple than *Trama*. It feeds on grass roots and is often found in ants' nests.

Genus **Rhizobius** BURMEISTER. Plate IV, figs. 25 and 26.

Antennæ five-jointed, the first four nearly equal in length. Eyes inconspicuous. Beak very short, rising between the first coxæ. No winged form known. Legs short, the tarsi terminated with but one claw. Body has a coating to some extent of flocculent material. Honey-tubes and style absent. Different authors do not agree on the number of joints of the antennæ. Passerini says six, Fitch five or six, Thomas seven, and Buckton adds that the characters are very inconstant. This genus is subterranean in habit and lives on the roots of plants.

---

[7] Although all the genera given do not have representatives in this text, it is nevertheless thought best to give the former that have been found in America.

[8] No representative in text; genus? sp.

Head dirty gray. Antennæ a little darker and slightly pilose; length of joints: I, 0.10 mm.; II, 0.10 mm.; III, 0.18 mm.; IV, 0.28 mm.; V, 0.20 mm.; VI, 0.05 mm.; total length, 0.90 mm., not quite half the length of the body. Sensoria are absent except at the base of the unguis, where one is located. Eyes abnormal, small and black, with three ocelli instead of the common cornea. Ocelli not located in the normal position but cephalad and near the bases of the antennæ. They are large, translucent and situated in dark patches, each separate from the other. The beak is four-jointed, slightly hirsute and dark, except the first joint, which is lighter in color. Length, 3.44 mm., extending about one-half its length beyond the abdomen.

Thoracic lobes not distinctly divided, nor separate from the head. All grayish in color. The legs are darker than the abdomen, slightly pilose and stout. Honey-tubes and style entirely obsolete. Length of body, 2.08 mm.

This form was taken April 25, in an ants' nest which was in an old walnut stump in a small copse of timber. It is pulverulent and similar in action to other underground species.

From all appearances this form had hibernated in the ants' nest all winter. Only three were found. I expected to collect more during the summer, but none were to be found in the nest or on the trees in proximity to it.

Subfamily CHERMAPHINÆ.

Antennæ three- or five-jointed. Eyes nearly always large and prominent. Beak short, or never very long. Prothorax large, sometimes equally developed to the thorax. Cephalic wing with three simple oblique veins (plate III, fig. 22); caudal may or may not have an oblique vein. Legs short; tarsi with two claws. Honey-tubes absent.

This tribe is in many respects similar to the Coccidæ.

Genus **Phylloxera** Fonsc.

Antennæ three-jointed; the first and second short and nearly equal; the third the longest, imbricated; it has two sensoria, one circular one near the base and one more elongate near the distal end. Sometimes total length is equal to one-third the length of the body. Eyes small and almost rudimentary in the apterous females. In the adult or winged form they are more normal. Beak absent in the perfect sexes, and moderately long. Wings rather large in proportion to the body; membrane delicate; upper wing with a well-marked subcostal from which spring three faint oblique simple veins. Caudal wing with a veinless cubitus. Both wings overlap and are held horizontally in repose. Legs very short; tarsi single-jointed according to previous description, but this is evidently an error, since I have found them to have two joints at all stages. The tarsi are furnished with two claws, two capitate bristles near the distal end, and a pulvillus. Abdomen globular in the apterous, and ovate in the winged forms. Honey-tubes absent.

Genus Chermaphis LINN.

Antennæ very short, reaching but little beyond the neck when turned back, composed of five joints, the two basal joints short, the remaining ones generally subequal in length, the fifth oval. Front wings rather large, transparent, the two discoidals and stigmatic veins appearing as three oblique branch veins; stigma usually elongated and much pointed at the tip. Hind wings with one more or less distinct branch vein.

Legs in the winged individuals rather short, the posterior pair usually not longer than the middle pair, all rather short; in the apterous individual very short. Body of the winged individual regularly oval; of the apterous, nearly circular and convex. No honey-tubes. Usually more or less covered with a cottony secretion.

The species so far as observed appear to be more particularly confined to coniferous trees.

Phylloxera caryæcaulis FITCH. **Plate IV, fig. 27.**

Head dark. Antennæ dark, imbricated, and composed of three joints; length of segments: I, 0.03 mm.; II, 0.01 mm.; III, 0.16 mm.; total length, 0.21 mm., extending to the wing insertions. There is one circular sensorium on the third joint about one-third of the length of the joint from the base. On the distal third is what appears to be an elongate sensorium which is not distinct. Eyes red; ocular tubercles present; ocelli prominent and red. Beak dark, 0.18 mm. long, extending to the mesocoxæ.

Prothorax pale yellow. Thorax a shade darker yellow;

wings pellucid, venation not distinct but darker than the remainder of the wing. Stigma dark, sometimes extending to the proximal part of the wing, but generally more normal, as shown in the illustration, being 0.09 mm. broad, and 0.36 mm. long. Legs pale yellow, slightly hirsute, and normal in length ; tarsi (two-jointed in young and old) normal, except being mounted with two capitate hairs near the claws, as shown in the illustration. Other hairs, but not capitate, are present, as shown in the figure.

Abdomen greenish yellow. Honey-tubes obsolete. Abdomen nearly always drawn out pointed at the distal end. Total length of the body, 1.09 mm. For an illustration of the apterous stem-mother, see plate XXII, figure 101.

This form was taken May 25, on hickory (*Carya amara*). The forms are gregarious and live in reddish galls on the main trunk of the tree. Following is Mr. Burrows's description of the gall :[9]

"*Phylloxera caryæcaulis* (?) Fitch. This species forms large stem galls on the hickory (*Carya amara*). The gall is bullet-shaped, with a tough leathery covering; green when young, turning to a red in the sunlight, resembling a large strawberry. These galls are about 25 mm. in diameter, with a large hollow cavity enclosed by a wall 2 mm. in thickness, which is covered with yellow lice. The galls appear about April 15, and winged lice appear about May 26, and even in June I have seen small green galls from which aphids emerged. I am inclined to believe that there are two broods of gall-making stem-mothers of this species during the year. The galls appear on the twigs and young shoots of the tree, and are deformed buds as far as I have observed. On the upper surface of the gall I have found several growing bunches of leaves which were normal leaves of the deformed bud. A slight evidence of deformed leaves may be found in the thick, succulent walls of the young galls."

Subfamily PEMPHIGINÆ.

Antennæ short, with five or six joints. Third joint the longest, and about equal, when six-jointed, to the three following taken together. The third and following joints are nearly always annulated with transverse sensoria, but when not annulated the sensoria are circular. Eyes large in the winged form, but in the gall-inhabiting, apterous form they may be small or absent. Beak long in the adult, or absent in the true sexes. Thorax generally well arched. Wings moderately long. The third discoidal is simple and hyaline or obsolete at the base. The first and second discoidals usually start from the same point or not far apart. The caudal wing has two discoidals (except in *Hormaphis*, which has but one), which arise from an angle in the subcostal vein. Legs short; tarsi with two claws and sometimes with a pair of capitate hairs. Honey-tubes obsolete. Style inconspicuous or none.

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[9] From M. T. Burrows's unpublished manuscript on galls.

Genus **Hormaphis** OSTEN-SACKEN.[10]

Antennæ five-jointed; first and second short, third the longest, fourth and fifth subequal; the last three joints strongly annulated. Eyes conspicuous. Beak moderately long. Front wings with two discoidals starting from the same point; the third discoidal is simple and almost obsolete at the base. Hind wings with a single discoidal which is almost obsolete. Legs moderately long; tarsi mounted at the distal part with two long capitate hairs. Honey-tubes and style absent.

Genus **Tetraneura** HARTIG.

Antennæ short, extending nearly to the abdomen; the third joint distinctly annulated. Beak short. Wings with a simple cubital which is obsolete at its base; stigma large and trapezoidal; the first and second discoidals usually arise at the same point. The subcostal vein of the caudal wing with only one discoidal. Legs short. Honey-tubes and style obsolete.

Genus **Geoica** HARTIG.[11]

Antennæ five-jointed, not annulated; first and second joints short; third longest; fourth and fifth shorter, subequal, often connate, the fifth with a short, thick spur at the tip. Sensoria present on the third antennal joint of the winged individual, and in all of the forms at the apex of the fourth joint and base of spur on the fifth, the latter sensorium lunate in the wingless individuals. None present on the tibia of the oviparous female. Eyes distinct. Beak rather short and thick, last two

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[10] No representative of this genus described in this text.

[11] No representative in text.

joints longer than the basal portion. Fore wings with the stigma large, the cubital simple, obsolete basally, the two discoidals united at the base. Hind wings without discoidal vein. Two distinct tarsal joints and two claws on all the legs. Anal plate flattened, drawn forward dorsally and compressing middle of posterior segments, cauda short, transverse, inconspicuous. Cornicles and excretory glands wanting.

Genus **Pemphigus** Hartig.

Antennæ not more than half the length of the body, six-jointed; third joint about equal to the three following taken together; third, fourth and fifth joints commonly annulated. Eyes large in the winged form, but often rudimentary or absent in the apterous form. Beak moderately long in the adult, but much longer in the young. The first two discoidals arise from nearly the same point, the third is simple and obsolete at the base; stigma rather short and broad. The two discoidals in the caudal wing arise from somewhat of an angle in the subcostal vein. Thorax much developed and distinctly arched. Legs moderately long in the winged form, but short in the apterous form. Honey-tubes absent. Style rudimentary or absent.

Pemphigus burrowi, n. sp. Plate IV, fig. 30.

Head black. Antennæ slightly hirsute, and concolorous with the head; length of segments: I, 0.05 mm.; II, 0.07 mm.; III, 0.21 mm.; IV, 0.09 mm.; V, 0.11 mm; VI, 0.16 mm., including unguis, which is 0.03 mm.; total length, about 0.65 mm. Sensoria mostly transverse, but not encircling the segments as do the sensoria of the *S. americana;* on the third joint are five or six; on the fourth one; on the fifth are five circular ones in a circular patch at the distal end of the segment, each bordered with a fringe of four or five bristles. The sixth has an irregular patch of nearly circular sensoria near the distal end which are bordered with bristles. The eyes are black; ocelli not prominent, but those near the eyes border them dorsocephalad very closely. On the front is the one most prominent between the bases of the antennæ. All are bordered with black. The beak is dark and extends midway between the first and second coxæ, being 0.34 mm. long.

The prothorax is whitish and very short. The thorax is strongly arched and black. Wings are hyaline. Subcostal vein robust, discoidals slender. Third discoidal obsolete at the base. All the veins are nearly obsolete at their distal margins. Stigma, costal and subcostal uniformly of a brownish black. Stigma, 0.18 mm. broad and 0.75 mm. long. Distal part of stigma sharp in some, in others more rounded. Total wing expansion, 6.61 mm. Legs dark and slightly pilose, also short in proportion to the body. The distal joint of the tarsus is exceptionally long. Honey-tubes and style are absent. Abdomen pale yellow, with no honey-tubes or style; total length of body, 2.35 mm.

This form is gregarious and apparently subterranean in habit. April 30 the winged form was taken on the roots of the nasturtium (*Nasturtium sinuatum*). The forms at that time seemed to be developing wings for migration. Soon after this time the Kaw river valley was inundated and none of these forms have been taken since. On account of their pulverulent secretion they can withstand a small amount of water, but enough to kill their host-plant is too much for them.

Pemphigus fraxinifolii Riley. Plate IV, fig. 28.

Head dusky. Antennæ dusky and bare; length of segments: I, 0.05 mm.; II, 0.07 mm.; III, 0.25 mm.; IV, 0.12 mm.; V, 0.16 mm.; VI, 0.28 mm., including the unguis; the unguis alone, 0.03 mm.; total length of the antennæ, 0.93 mm., extending to the abdomen. Sensoria irregularly circular or nearly transverse, but not encircling the segment; seven on the third joint, four or five on the fourth, the proximal one being quadrate in outline; six or seven on the fifth, the distal one being very irregular in outline; about four on the sixth, the distal one being at the base of the unguis. Eyes black; ocular tubercles quite prominent; one frontal ocellus and three dorsal pairs. The extra two dorsal pairs near the median line may not be ocelli, but they resemble them very much in appearance. Beak dusky, 0.45 mm. long, extending a little more than midway between the pro- and mesocoxæ.

Prothorax short, conspicuously marked with two light-colored circular spots. Thorax dusky, marked near the ventral part with two pear-shaped light spots, as shown in the illustration. Wings hyaline, with slender pale and frail veins. Stigma, 0.18 mm. broad and 0.81 mm. long. What appear to be sensoria are situated along the subcostal vein near the stigma. An enlarged view of the same is shown at *a*, in the illustration. Total wing expansion, 6.00 mm. Legs normal, with the exception of long tarsi, they being 0.25 mm. long.

The abdomen is dark green or yellowish green after the cottony secretion is removed. Honey-tubes and style obsolete. Total length of the body, 1.82 mm.

This form was taken June 21, on the ash (*Fraxinus americanus*). It is gregarious, and colonizes the terminal leaves, which causes them to curl and form a pseudogall that protects the lice.

Pemphigus populicaulis Fitch. **Plate VI, fig. 40.**

Apterous form.—Head black. Antennæ black; length of joints: I, 0.03 mm.; II, 0.05 mm.; III, 0.10 mm.; IV, 0.07 mm.; total length, 0.25 mm. Eyes black, the cornea, of which there are three, resemble ocelli, and lie in the black pigment of what corresponds to the eye. Beak black, 0.27 mm. long, extending midway between the pro- and mesocoxæ.

Thoracic divisions not differentiated from the remainder of the segments. Legs black and short.

Abdomen large and spherical, also pulverulent. Honey-tubes and style obsolete.

This form was taken May 17, in a cottonwood gall. This gall is on the petiole at the base of the leaf. The interior of the gall is smooth, and contains besides the exuviæ of the lice several liquid globules coated with a pulverulent matter which gives it the appearance of mercury in its behavior, since it retains a globular form. All the insects in the gall, sometimes numbering 500, have this same coating of pulverulent matter. They are produced at the rate of about ten per day. Usually there is but one viviparous mother in the colony, but sometimes two are found. An illustration of the stem-mother is shown in plate V, figure 34. These forms were taken July 17. The adults are at this time leaving the galls, but they were not found in any other place. Yet, under artificial conditions, they were observed laying their eggs on apple twigs.

Following is Mr. Burrows's description of the gall: "This gall occurs throughout the summer on the petiole of the leaf of the cottonwood (*Populus monilifera*). The gall is a subglobular, swelling slightly, elongated towards a lip-like opening; 15 mm. in diameter; green while growing, but of a straw color at maturity; walls thick, firm, and succulent. The opening is short and is always parallel with the lower border of the leaf. The petiole bends nearly always to the left around the outer border of the gall at an angle a little greater than a right angle. The young lice remain in the gall until maturity."

There are many broods of this gall produced throughout the summer. They are seen in the early spring and in the late fall. Very common.

Pemphigus populicaulis Fitch. Plate V, fig 33.

Head dark brown. Antennæ dark; length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.16 mm.; IV, 0.07 mm.; V, 0.09 mm.; VI, 0.14 mm., including the unguis; unguis alone, 0.01 mm.; total length of antennæ, 0.54 mm., extending to the insertion of the front wings. Sensoria transverse, nine on the third joint, and at the lateral inner margin of the third sensoria is a short conspicuous spur, similar to the one on the first sensoria of the *populitransversus*. Three sensoria on the fourth joint, three on fifth, with an irregular sensorial near the distal end which contains a few small circular sensoria. On the sixth are five transverse sensoria, while an irregular sensorial patch is near the distal end. Eyes are black, ocular tubercles not very prominent, ocelli large, but not conspicuous. Beak extends midway between the pro- and mesocoxæ, being 0.36 mm. long.

Prothorax short and lighter in color than the head; thorax dark brown. Wings hyaline, veins dark, stigma is lighter in the central part than the subcostal vein; 0.41 mm. long by 0.14 mm. broad. Total wing expansion, 4.50 mm. The two discoidals of the hind wing seem to arise from each side of the subcostal. Legs black and rather small in proportion to the body.

Abdomen greenish and pulverulent. Honey-tubes obsolete. Style not conspicuous but the abdomen ending with a somewhat conical segment. Total length of the body, 3.26 mm.

This form is very similar to the *populitransversus* but is most easily distinguished by having more sensoria on the antennæ. It is gregarious and forms a gall on the cottonwood (*Populus* *monilifera?*) similar to that formed by the other species, yet differing in that the petiole seems to be twisted or folded so that the gall is formed. It is from a fourth to three-fourths of an inch in diameter, with a narrow transverse opening on one side where the petiole overlaps, which allows the emigration of the adult forms.

Pemphigus populitransversus Riley. Plate IV, fig. 29.

Head and antennæ black. Length of segments: I, 0.09 mm.; II, 0.09 mm.; III, 0.02 mm.; IV, 0.09 mm.; V, 1.28 mm.; VI, with unguis 1.64 mm.; unguis alone, 0.03 mm.; total length, 0.74 mm., extending to the insertion of the fore wings. Sensoria transverse and broad, but not completely encircling the joints of the third and fourth segments. Three or four sensoria on the third segment, also a characteristic spur at the inner lateral border of the first sensorium. Two sensoria on the fourth, a large circular patch containing three or four small circular sensoria, which have ten or twelve small papillary hairs on their surfaces. One large sensory patch on the sixth near the unguis, which has in it two or three small circular sensoria containing hairs similar to those of the fifth sensorium. Unguis is armoured with about six small, sharp bristles at its distal end. Eyes black, ocular tubercles prominent, ocelli three, and not very conspicuous. Beak dark, 0.27 mm. long, extending a little beyond the first coxa.

Prothorax smoky; thorax black and arched. Wings hyaline, with a brownish venation. Stigma uniform in color, 0.72 mm. long by 0.20 mm. wide. Total wing expansion, 6.64 mm. Legs black, slightly hirsute.

Abdomen smoky yellow. Honey-tubes and style absent. Total length of body, 2.72 mm.

This form was taken the 8th of October, on the cottonwood (*Populus monilifera*). It is gregarious in habit, living in a gall in the distal end of the petiole. This gall is from one- to three-fourths of an inch in diameter. It has a small transverse opening near and parallel to the base of the leaf, through which the adults emerge. In these colonies of from a hundred to four hundred is one and sometimes two stem-mothers. These are apterous and reproduce viviparously at the rate of about ten per day. In these galls are numerous globules of liquid which has a waxy coating that gives it a similarity to mercury in action and appearance. The insects also have this pulverulent coating.

Tetraneura ulmi De G. Plate V, fig 34.

Head black. Antennæ dark and annulated; length of segments: I, 0.01 mm.; II, 0.03 mm.; III, 0.16 mm.; IV, 0.07 mm.; V, 0.05 mm.; VI, 0.06 mm., including the unguis; unguis alone, 0.01 mm.; total length, 0.43 mm. Eyes black and large in proportion to the head; ocular tubercles present; ocelli large and of a reddish color. Beak dark, 0.18 mm. long, extending midway between the pro- and mesacoxæ.

Prothorax brownish, short and almost covered dorsally by the mesathorax. Latter dark; wings pellucid, venation dark. Stigma, 0.14 mm. wide and 0.45 mm. long. Total wing expansion, 4.84 mm. Legs dark, slightly hirsute, and normal in length.

Abdomen yellowish brown. Honey-tubes tuberculate. Style obsolete. Total length of body, 1.99 mm.

This form was taken June 26, on the elm (*Ulmus americana*). It is gregarious, and lives in what is known as a cockscomb gall. Following is Mr. Burrows's description of the gall: "This species forms a cockscomb-like gall on the upper side of the leaf of the elm (*Ulmus americana*) in June, on the outer young leaves. The gall is usually about 25 mm. in length and about 8 mm. in height, and is very conspicuous, being truly cockscomb-shaped. Its sides are grooved with perpendicular wrinkles and its summit toothed. In early summer the gall is a light green color, lighter than the leaf, turning red after some exposure to the sun. It dies and becomes a straw color when the insect emerges. The gall has an external opening on the under side of the leaf, which is a slit-like orifice. The interior of the gall has wrinkles corresponding to the exterior. These galls are not common in this region, being obtained from only one small elm tree on the Wakarusa river, July 1. This species attacked only the young trees, as far as could be observed; the larger trees surrounding this tree had no galls, while this young tree and surrounding sprouts were covered with them. Riley[12] says that there are several generations of this gall-producing insect during the year, containing but two broods of gall-making females, and that no galls are formed except by the stem-mothers that hatch from the impregnated egg."

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[12] Riley, Bull. U. S. Geol. Surv, vol. V, p. 9.

Mr. Burrows is working on gall-producing insects, which is collateral to this subject, and it is from some of his unpublished manuscript that this reference is taken. Our collecting has been done in the same locality.

Subfamily SCHIZONEURINÆ.

Antennæ short, about half the length of the body or shorter. Six-jointed. When annulated, with transverse sensoria, or when not annulated, with circular sensoria. Eyes in winged form conspicuous, rudimentary or obsolete in some of the apterous forms. Beak in young forms may extend to the caudal end of the abdomen, moderately long in the adults and absent in some of the true sexes. Thorax moderately arched. The first and second discoidal of the cephalic wing usually arise near each other. The third discoidal is once branched and obsolete at the base. Caudal wing may have one or two discoidals. Abdomen generally has a flocculent or pulverulent covering. Honey-tubes rudimentary or absent. Style inconspicuous, globular, or obsolete. The species in this subfamily may vary in habit, some being subterranean, and some gall-inhabiting, while others may live unprotected.

Genus **Colopha** Monell.

Antennæ six-jointed, third joint as long as the three following and not extending beyond the thorax. Beak short. First two discoidals of the front wing arising from nearly the same point, cubital once branched. Caudal wings, with only one discoidal. Honey-tubes and style wanting.

Genus **Toxoptera** Koch.[13]

Antennæ seven-jointed, on small remote frontal tubercles. Beak moderately long, extending to the mesacoxæ. Cephalic wings, with the cubital vein but once branched. Subcosta of the caudal wings with two discoidals. Legs stout and moderately long. Honey-tubes cylindrical and moderately long.

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[13] No representative in text.

Genus **Schizoneura** Hartig.

Antennæ six-jointed; the third joint the longest, fourth and fifth about equal in length. When annulated the sensoria are transverse, and when smooth the sensoria are circular. Beak moderately long in the adult, sometimes extending to the metacoxæ; in the young it sometimes extends to the end of the abdomen. Wings moderately long; the first two discoidals of the cephalic wing arise close together; the cubital is obsolete at the base and once branched. Subcostal vein of the caudal wings nearly straight, with two discoidals. Legs short. The body, with but few exceptions, is covered with a pulverulent or cottony secretion. Honey-tubes rudimentary or absent. Style obsolete or rudimentary.

Schizoneura americana Riley. Plate VI, fig. 37.

Head black. Antennæ dark, bare, and annulated with sensoria; length of joints: I, 0.05 mm.; II, 0.05 mm.; III, 0.37 mm.; IV, 0.09 mm.; V, 0.10 mm.; VI, 0.09 mm., including the unguis; latter alone, 0.01 mm.; total length of antennæ, 0.75 mm., extending to the insertion of the caudal wings. Sensoria transverse, about twenty-two on the third, four to six on the fourth, four to six on the fifth, about three on the sixth; also three or four small circular ones at the distal end of the sixth or base of the unguis. The distal end of the latter is armed with four or five short capitate hairs. Eyes black; ocular tubercles present but not prominent; ocelli present and conspicuous. Beak dark, 0.81 mm. long, extending to the mesocoxæ.

Prothorax short and dark; wings hyaline, venation medium in width, each bordered with a very faint smoky tinge on each side about twice as wide as the vein itself. Stigma dark, 0.19 mm. broad and 0.63 mm. long. Total wing expansion, 5.80 mm. Legs black, slightly hirsute, and normal.

Abdomen reddish brown; honey-tubes present but not conspicuous, being almost obsolete. Style obsolete. Total length of the body, 2.44 mm.

This form was taken June 16, on the elm (*Ulmus americana.*) They colorize the ventral side of the leaves, causing them to curl. When numerous they give the leaves a whitish appearance and cause the terminal ones to bunch together, which gives the lice more protection. When the leaves begin to turn yellow and look sickly from the attack of the aphids, the latter are acquiring wings and beginning to migrate. This migration, according to my friend Mr. E. H. Tucker's observation, takes place most conspicuously about twilight, for he says: "In the twilight of the evening I took several winged specimens. The air had floating in it numerous white insects. After capturing some I noticed that it was a cottony secretion which gave them their white appearance and also sustained them or caused them to be wafted along by the wind." According to this statement, the flocculent material acts as a sail by which these insects are carried as well as by the aid of their wings.

Schizoneura lanigera Hausm. **Plate V, fig. 36.**

Head black. Antennæ dark brown; length of joints: I, 0.07 mm.; II, 0.07 mm.; III, 0.469 mm.; IV, 0.109 mm.; V, 0.128 mm.; VI, 0.09 mm., including the unguis; total length, 8.5 mm. The sensoria are transverse, and give the antennæ an uneven appearance. There are on the third joint twenty-two, on the fourth joint five, on the fifth joint four, and on the sixth three. The eyes are dark brown, ocular tubercles are not conspicuous, ocelli normal. The beak is concolorous with the prothorax, and extends to the mesocoxæ, being 0.81 mm. long.

The prothorax is pale brown. The thorax is black on the sclerites and the membrane is pale brown. The wings are not clear. The venation is brown. The stigma is brown and 0.198 mm. broad by 0.50 mm. long. Total wing expansion, 9.4 mm. The legs are somewhat hirsute; femur dusky, approaching black at the distal ends; tibia and tarsi pale prown.

The abdomen is dusky brown; honey-tubes tuberculate, concolorous, and not very conspicuous; style is obsolete.

This form is quite common the whole year (as far as known it affects all cultivated apple trees except Northern Spy and Winter Majetan), but the winged state is rarely met. The winged form was taken on the 27th of October from an old scion apple orchard, in colonies with the wingless forms. The species is gregarious and may be located by the woolly secretion which grows out from certain glands on their bodies, as shown in figure 7. This is the typical underground and aerial form. It is not only found on the roots of the apple tree, but also on the tender bark, whether it be in a crevice or exposed, as on the water sprouts. The places most adaptable for them are on the tender bark which is overgrowing a wound where a branch has been pruned off. The secretion of the underground form is more of a pulverulent nature, and is impervious to water. This secretion on the aerial form grows out at the rate of 0.50 mm. per week, as found by actual experiment, and on account of this protection no parasites molest them as they do the less protected genera.

Schizoneura lanigera Hausm. Plate II, fig. 7.

Entire body chocolate brown after the bluish-white cottony secretion is removed. Length of antennal joints: I, 0.03 mm.; II, 0.05 mm.; III, 0.09 mm.; IV, 0.03 mm.; V, 0.07 mm.; VI, 0.07 mm., including the unguis; latter alone, 0.01 mm. A circular sensorium at the distal end of the fifth and the sixth joints. Eyes black; not hemispherical, as is normal, but small and black, with three or four of the cornea appearing as large and translucent ocelli. Ocular tubercles and ocelli absent. Beak, 0.36 mm. long, extending near to the second coxa. In the very young larva the beak is equal to the body in length.

Thoracic segments all similar and not characterized as lobes. Legs short. Abdomen large in proportion to the anterior divisions, and is about as broad as long. Honey-tubes almost obsolete, style not well developed, subobsolete, twice as wide as long, 0.07 mm. long and 0.14 mm. wide.

This form was collected with the winged form described. It is gregarious and colonizes the sprouts, wounded places and tender bark on the trunk and limbs, but is not found on the leaves.

Schizoneura corni Fab. Plate VI, fig. 38.

Head black. Antennæ dark and hirsute, about half as long as the body; length of segments: I, 0.054 mm.; II, 0.07 mm.; III, 0.198 mm.; IV, 0.09 mm.; V, 0.109 mm.; VI, 0.145 mm., including the unguis, which alone is 0.036 mm.; total length, 0.67 mm. The sensoria are large and circular; about six on the third joint, two on the fourth, two on the fifth, and one on the sixth at the base of the unguis. The eyes are black; ocular tubercles present; ocelli present but not very prominent.

Beak dark brown, extending to the mesocoxæ, being 0.54 mm. long.

The prothorax is broad and short; thorax broad; wings hyaline and covered with minute stipples; veins slender and brownish; cubitus obsolete at the base. Stigma brown and 0.50 mm. long by 0.198 mm. wide. Total wing expansion, 6.94 mm. Legs black and hirsute, metathoracic legs long in proportion to the others.

The first three segments of the abdomen are ferruginous, as are also the apical segments; remainder of the abdomen black. Honey-tubes reduced to a mere circular opening, and not very conspicuous. Style obsolete.

This form was taken in October on the ventral side of the leaves of the dogwood. It is gregarious and was found in great numbers. Later in the season it was found somewhat sporadic on a great many other plants in the vicinity of the dogwood, from which it seemed to have migrated.

Schizoneura, n. sp. Plate VI, fig. 41.

Head black. Antennæ black, bare, and uneven; length of segments: I, 0.03 mm.; II, 0.03 mm.; III, 0.21 mm.; IV, 0.07 mm.; V, 0.09 mm.; VI, 0.10 mm.; total length, 0.53 mm., extending to the wing insertion. Sensoria transverse, sixteen to twenty-four on the third joint, four on the fourth, eight to ten on the fifth, and eight or nine on the sixth. The distal end is armed with several spines. The eyes are dark red; ocular tubercles prominent; ocelli present, but not very conspicuous. Beak dark; in the pupa it extends to the mesocoxæ and is 0.27 mm. long.

Thorax all dark; wings pellucid, veins black; the discoidals and stigmal veins have a smoky border about equal in width on each side to the vein itself. Stigma black, 0.09 mm. broad and 0.36 mm. long. Total wing expansion, 3.60 mm. Legs dark, hirsute, and normal in length.

Abdomen dark brown. Honey-tubes tuberculate. Style obsolete.

This form was taken June 19, on the elm (*Ulmus americana?*). It is gregarious in galls, which my coworker describes as a new species. Following is his description: "This gall occurs on the dorsal side of the leaf of the elm (*Ulmus americana?*). The gall is large and elongated, tapering at both ends; sides sunken and irregular, due to the thin wall of the central cavity; 2½ c. in height and 1 cm. at its greatest diameter. The walls are of a leathery texture, green when young, turning to a straw color upon reaching maturity. The gall is firmly fastened to the leaf. The internal side of the gall is covered with plant-lice which emerge through a crack which occurs along the side of the gall, or some few through the small opening on the ventral side of the leaf."

The aphid is doubtless a new species which is somewhat similar to *Colophia ulmicola* Fitch, but does not agree with it on account of its tuberculate honey-tubes and two discoidals in the caudal wing. The illustration was made from a mutilated specimen and consequently does not show all the parts perfectly.

Subfamily LACHNINÆ.

Antennæ generally equal to half the length of the body, six-jointed. Beak long, extending to or beyond the mesocoxæ. Cephalic wings with three discoidals, the third one twice branched. Stigmal vein nearly straight, stigma extra long, inframarginal cell long and narrow. Caudal wings with two discoidals. Legs extra long, especially the tibiæ of the hind pair. Tarsi normal. Abdomen large and broad. Honey-tubes tuberculate, somewhat inconspicuous. Style globular, inconspicuous or absent.

This subfamily comprises our largest aphids. They live unprotected and are usually gregarious on the limbs and trunks of trees. Their coloration is of a protective nature, being similar to the surface on which they are found.

Genus **Lachnus** Bermeister.

Antennæ about half the length of the body, six-jointed; the third joint is the longest; the fourth, fifth and sixth are nearly equal in length. Beak very long, never shorter than half the body and sometimes much longer. Wings long and broad, stigma unusually long and narrow. The third discoidal is twice branched, and the stigmal vein is nearly straight. The caudal wing has two discoidals. Legs very long, especially the hind pair. Honey-tubes tuberculate. Style inconspicuous or obsolete. This genus comprises some of the largest aphids known.

Genus **Phyllaphis** Koch.[14]

Head convex and smooth. Antennæ moderately long, the third joint nearly twice the length of the fourth, the fifth equal to the sixth in length. Beak very short, wings long and broad, stigma long and trapezoidal, veins clear Body covered with a cottony secretion. Honey-tubes rudimentary. Style almost obsolete.

Lachnus longistigma Monell. Plate VI, fig 39.

Head dark brown. Antennæ of a darker brown, except the base of the third segment which is a lighter brown; all the joints are hirsute; length of joints: I, 0.19 mm.; II, 0.199 mm.; III, 1.23 mm.; IV, 0.59 mm.; V, 0.59 mm.; VI, 0.39 mm., including the unguis, which is 0.11 mm. long; total antennal length, 3.15 mm. Sensoria large and circular but indistinct; eight on the third joint in a single row; three small and two large ones on the fourth joint; one near the distal end of the fifth as large in diameter as the segment itself; one large with four small laterad this at distal end of the sixth proper, and one small at the base of the unguis. Three large sensoria on the subcostal vein of the front wing. Eyes are black, and the ocular tubercles are small. The two dorsal ocelli are not as prominent as the cephalic one. The beak is concolorous with the head and extends a little caudad of the mesocoxæ, being 0.27 mm. long.

The prothorax is short and narrower cephalad than caudad. The thorax is dark brown. The wings are light brown, venation brown or dark. The first two discoidals are robust, with smoky borders. The cubitus is frail, faintly bordered with brown, and obsolete at the base. Stigmal vein is nearly straight and very faintly bordered with brown. The coloration of the subcostal extends around the distal end of the wing, ending between the distal end of the third cubital and the stigmal vein. The stigma is 0.90 mm. long by 0.22 mm. broad. The distal end of the stigmal cell is plainly marked, making the stigmal cell alone 0.22 mm. long, but the stigma proper, 2.17 mm. long. Total wing expansion is 19.00 mm. The caudal wing shows a marked peculiarity toward specialization in that it often has the second discoidal branched. The costal vein has a broad border of brown which also borders the subcostal vein. This latter vein seems to arise distad of the second discoidal, and from this point it gradually extends in breadth to the base of the wing. There are ten hooklets on this wing. The legs are hirsute; femora reddish yellow proximad, and the remainder of the leg black. The metathoracic legs are abnormally long. The others are also long in proportion to the body.

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[14] No representative in text.

The abdomen is large and hirsute, having a grayish general appearance. One lateral black spot on each tergum. Honey-tubes are concolorous with the abdomen, and are as broad as long, tuberculate, and 0.50 mm. long. The style is obsolete. Entire length of the body, 7 mm.

This form has been numerous here all summer. They are gregarious and colonize the small limbs and trunks of trees. They are very gentle and droll-like in their habits. In cold weather they collect on the under side of the limbs, and insert their beaks, which seem to support them when their feet become too numb to support them. Even after they are dead they still remain on the limbs clinging with their beaks. In endurance of extremes of weather they are similar to the *Schizoneura lanigera.* They were among some of the first winged forms to appear this spring and were the last to disappear, having endured all temperatures from — to zero, F.

On account of their feeding habits they can live through the winter where it gets no colder than zero, since they feed from the sap of the tree and not from the sap of the leaves. This is the largest aphid known. Following are the food-plants upon which I have found it this year (1903): Soft maple (*Acer dasycarpum*), Pig hickory (*Carya amara*), Black walnut (*Juglans nigra*), oak (*Quercus marylandica*), *redbud* (*Cercus canadensis*), sycamore (*Platanus occidentalis*), and cottonwood (*Populus balsamifera*).

Subfamily APHIDINÆ.

Antennæ seven-jointed, moderately long, often longer than the body. Eyes present, with distinct ocular tubercles (except in *Callipterini*). Beak variable in length. Cephalic wings with three discoidals; third one twice branched; stigmal vein curved. Caudal wings with two discoidals. Legs generally of a moderate length. Tarsi two-jointed and with two claws (except in *Mastopoda*). Honey-tubes of different lengths, seldom tuberculate or absent. Style always present.

This is one of the largest subfamilies. In habit the species are the most variable.

For convenience this subfamily may be divided into the three following tribes:

3. Antennæ on conspicuous frontal tubercles; style long, never shorter than the tarsi.......... *Macrosiphini.*
   Antennæ on inconspicuous frontal tubercles or none; style short or none, never longer than the tarsi.......... 2.
2. Style conical; honey-tubes cylindrical, or rarely incrassate.......... *Aphidini.*
1. Style obsolete or globular; honey-tubes tuberculate, or distinctly incrassate.......... *Callipterini.*

Tribe CALLIPTERINI.

Antennæ not constant, as a tribal characteristic, being variable in length, sometimes shorter, sometimes longer, than the body; when shorter they are generally hirsute; always seven-jointed, but the seventh may not always be as long as the sixth; never on frontal tubercles (except in *Drepanosiphum*). Beak short (except in *Melanoxanthus*). Wings often clouded by vein borders or patches. Abdomen usually elongate and somewhat flat, often tuberculate or hairy. Honey-tubes, when tuberculate, strong, distinctly incrassate or obsolete. Style globular or none.

Genus **Cladobius** Koch.[15]

Vertex flat between the antennæ. Antennæ seven-jointed and about half the length of the body; the third joint about twice the length of the fourth. Beak extending to the mesocoxæ. Prothorax with a lateral tubercle. Wings moderately long. Legs normal and hirsute. Abdomen oval. Honey-tubes vasiform. Style globular or absent.

Genus **Chaitophorus** Koch.

Front of head tufted with bristles. Antennæ hirsute, seven-jointed, about half the length of the body. Beak short, sometimes extending a little caudad of the mesocoxæ. Wing venation normal, with the addition of smoky borders and spots. Legs hirsute and moderately long. Abdomen usually tuberculate, and with long slender hairs, which are never capitate, as is often the case in *Callipterus*. Honey-tubes short and thick, tuberculate, rarely subobsolete. Style tuberculate.

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[15] No representative in this text.

Genus **Callipterus** Koch.

Head large, vertex flat. Antennæ smooth, usually about as long as the body but sometimes much longer, seven-jointed, seventh joint rarely less than the sixth,[16] but variable in length. Sensoria of the third joint in a single row. Beak does not extend beyond the mesocoxæ. Wings frequently clouded, stigma short and concave on the cephalic border. Venation gracefully curved. Legs moderately long. Abdomen hirsute in some species of apterous females. Apical segment with two anal valves. Honey-tubes short. Style knobbed. This genus comprises some of the most beautiful forms of the Aphidinæ.

Genus **Calaphis** Walsh.[17]

Antennæ long, linear, seven-jointed, fourth shorter than the third, fifth shorter than the fourth, six less than one-half as long as fifth, seventh slender and twice as long as the sixth. Prothorax more than one-half as long as the thorax. Honey-tubes moderate. Wings steeply roofed and differing from those of *Aphis* only in the total absence of the fourth or stigmal vein and the usually robust discoidal veins.

Genus **Cryptosiphum** Buckston.[17]

Vertex convex. Antennæ very short in the apterous, but longer in the winged form; seventh joint one and one-half times the length of the sixth. Beak extends to the mesocoxæ. Wings short, rounded, and venation normal. Legs rather short. Honey-tubes absent or rudimentary. Style small but distinct in the winged form.

Genus **Monellia** Oestlund.[17]

Antennæ longer than the body, on no frontal tubercles. Beak very short. Thorax low and flat; prothorax nearly as large as the thorax proper. Wings held horizontal in repose; venation as in *Callipterus*. Honey-tubes not obvious. Style short, enlarged at the apex. In general the insects are small and delicate, of a pale color and strongly depressed body.

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[16] This is an exception to the rule of not counting the unguis or seventh joint when shorter than the sixth joint.

[17] No representative in this text.

Genus **Drepanosiphum** Koch.

Antennæ longer than the body and fixed on frontal tubercles; setaceous seventh joint as long or longer than the third, latter with a single row of rather large sensoria. Eyes bright red. Beak short; penultimate joint long in proportion. Wings long and narrow; marginal cell elongated towards the apex of the wing. Discoidals nearly parallel to each other. Honey-tubes moderately long, enlarged near the base. Style inconspicuous or none.

Chaitophorus. Plate VII, fig. 43.

Head black. Antennæ hirsute, dark, darkest on the distal half; length of segments: I, 0.05 mm.; II, 0.03 mm.; III, 0.16 mm.; IV, 0.12 mm.; V, 0.1 mm.; VI, 0.07 mm.; VII, 0.25 mm.; total length about 0.80 mm., extending a little beyond the thorax. Sensoria circular and not equal in size. There are about twelve on the third joint, sometimes one on the fourth, two on the fifth, and eight small and one large one on the distal end of the sixth. Eyes red, ocular tubercles prominent, and ocelli normal. Beak pale yellow, 0.23 mm. long, its extent being midway between the pro- and mesocoxæ.

Prothorax black, its lateral tubercles not very conspicuous. Thorax black; wings pellucid, veins light brown. Stigma dark brown, 0.14 mm. broad and 0.54 long. Total wing expansion, 4.35 mm. Legs dark, hirsute with longer hairs than are shown in the illustration.

Abdomen and the rest of the body armed with long hairs which are mounted on small pale yellow tubercles. Terga colored with transverse black bands which frequently become confluent on the median line. Black spots laterad of these are on each margin of the terga. Honey-tubes black, imbricated, and about as long as broad. Style black, armed with long hairs. It is distinctly knobbed and equal to the honey-tubes in length, being 0.50 mm. Total length of the body, 1.37 mm.

This form was taken May 25, on the willow (*Salix glaucophylla*). It is gregarious in habit and colonizes the leaves. These aphids were apparently exterminated here three times last year, by the ladybird beetles, in a certain willow grove which was nearly submerged by water for a period of nearly a week. The gradual rise of water drowned or drove the aphids to the tops of the trees. Here they fell an easy prey to the bugs which had previously increased, and all were apparently exterminated by the latter. Then the bugs soon disappeared, presumably for want of food material. Soon the aphids appeared again as numerous as at first. Later the bugs reappeared and the aphids disappeared. This alternation happened three times during the summer.

Among the honey-dew feeders was noticed a Tenthridenid, which obtained the juice as the ant ordinarily does, that is, by attracting the aphids' attention with its antennæ.

Chaitophorus negundinus THOMAS. Plate X, fig. 58.

Head brownish and hirsute. Antennæ dusky except at the bases where they are paler, also very hirsute; length of joints: I, 0.09 mm.; II, 0.072 mm.; III, 0.43 mm.; IV, 0.27 mm.; V, 0.21 mm.; VI, 0.11 mm.; VII, 0.21 mm.; total length, 1.39 mm. Sensoria large, circular; five to ten on the third segment, none on the fourth, one near distal end of the fifth, about five or six small and one large one at the distal end of the sixth. Eyes in young pinkish red and in the adult black. Ocelli three in number and prominent; ocular tubercle prominent. Beak, 0.63 mm. long, extending to second coxa; it is dark at the tip, the remainder is pale yellow.

Prothorax greenish and hirsute. Thoracic sclerites dark, insertions light green. Wings hyaline, veins smoky black, discoidals narrow. Stigma smoky, varying from a light to a dark color; 0.16 mm. broad by 1.28 mm. long. Total wing expansion, 7.24 mm. Legs hirsute, slightly dark at distal ends of articulations. Stout and heavy in proportion to the body.

Abdomen pale green. Honey-tubes darker than the abdomen, 0.09 mm. long, and broader at the bases than in the center. Length of body, 2.35 mm.

This form is gregarious on the box-elder (*Negundo aceroides*). Its colonies sometimes completely cover all the growing parts of the tree. The tree, after being infested in this way, soon becomes coated with a honey-like secretion which seals the breathing pores of the leaves and the aphid is forced to leave for the want of food. After the aphid emigrates the tree puts out new foliage and resumes its growth, if attacked early in the season. This happened here in April, during which time the viviparous winged forms were plentiful.

Chaitophorus populicola Fitch. Plate VII, fig. 42.

Head black. Antennæ black and very hirsute; length of segments: I, 0.01 mm.; II, 0.09 mm.; III, 0.45 mm.; IV, 0.27 mm.; V, 0.19 mm.; VI, 0.09 mm.; VII, 0.21 mm.; total length, 1.37 mm., extending nearly to the central part of abdomen. Sensoria circular; about forty on the third segment, about twenty on the fourth, fifteen on the fifth, and a large one closely connected with about five small ones at the distal end of the sixth. Eyes black; ocular tubercles present but not conspicuous. Beak dark, extending to the mesocoxæ, being 0.63 mm. long.

Prothorax and thorax black. Wings smoky, veins black, robust. Stigma dark, 0.63 mm. long by 0.18 mm. broad. Total wing expansion, 5.76 mm. Legs of good size, black and hairy.

Abdomen greenish black, nearly always marked with black transverse bars, also with a marginal row of black patches. Honey-tubes greenish black, 0.09 mm. long, nearly one-half the tarsi in length. Style almost obsolete, hirsute, distal half black, about 0.07 mm. in length, or nearly as long as the honey-tubes. Body all hirsute, and 2.54 mm. long.

This form was taken on the leaves of the cottonwood (*Populus monilifera*), October 12. Being gregarious in habit, it colonizes both sides of the leaves. The colonies, which live through the summer, are closely guarded by ants, which protect them from their insect enemies. It was a large black species of ant which protected the forms taken and described. About one ant would have charge of a single leaf, and would fight until killed or thrown away from his flock. This aphid was common here during the summer months.

Chaitophorus stevensis, n. sp. Plate VII, fig. 47.

Head black. Antennæ dark, distal half black, all hirsute; length of segments: I, 0.128 mm.; II, 0.07 mm.; III, 0.41 mm.; IV, 0.3 mm.; V, 0.25 mm.; VI, 0.09 mm.; VII, 0.1 mm.; total length, 1.17 mm., extending to near the center of the abdomen. Sensoria circular; fifteen to twenty on the third segment, none on the fourth, the usual one near the distal end of the fifth, and a cluster of ten or twelve at the distal end of the sixth. Eyes black, ocular tubercles prominent and tinged with red. Ocelli present. Beak black, 0.45 mm. long, extending midway between the pro- and mesocoxæ.

Prothorax dark, thorax black. Wings hyaline, venation slender and of a dark brown color. Stigma, 0.65 mm. long by 0.16 mm. broad. Total wing expansion, 6.00 mm. Legs hirsute, femora, tarsi and distal part of tibia black, remainder yellowish.

Abdomen greenish yellow, hirsute, bordered laterally with eight black spots, and on the dorsal surface are eight black transverse bars. Honey-tubes black, 0.14 mm. long, or about equal to the tarsi in length. They are also incrassate and imbricated. Style hirsute, knobbed, the latter black, base greenish yellow, 0.09 mm. long, or about one-half the length of the honey-tubes. Total length of the body, 2.18 mm.

This form was taken July 9 in a cottonwood gall, and is named in honor of my professor in botany, W. C. Stevens.

Following is the description of the gall as given by Mr. Burrows:[18] "This gall occurs on the ventral side of the leaf of the cottonwood (*Populus monilifera*) in early summer. The gall is an elongated, semielliptical swelling of the midrib near the center of the leaf; 10 mm. in length and 5 mm. in height; green in color when young but of a straw color during maturity; walls thin, firm, and succulent. The gall has a mouth-like opening on the dorsal side of the leaf, which remains slightly open. This orifice runs parallel with the midrib nearly the length of the gall. The leaf folds dorsally along the midrib, enclosing the orifice of the gall. The young lice are found both in the gall with the stem-mother and outside clustered around the opening, being protected there by the fold of the leaf. The lice are protected with a white powder-like excrescence. These galls are not common in this region. I am under the impression that, owing to the early disappearance of this gall, only one brood of gall-producing stem-mothers exist during the summer, which brood, without doubt, comes from the impregnated egg. The subsequent broods do not have the power of producing galls."

Chaitophorus flabellus, n. sp. Plate XX, fig. 95.

Head dark and cone-shaped, as shown in the illustration. Antennæ black, except the basal half of the third joint, which is light brown; length of joints: I, 0.10 mm.; II, 0.07 mm.; III, 0.45 mm.; IV, 0.21 mm.; V, 0.21 mm.; VI, 0.12 mm.; VII, 0.23 mm.; total length, 1.59 mm., being about equal to the body in length. Sensoria circular and few, usual distal one present on the fifth, one equal to this in size on the distal end of the sixth, and a smaller one at the basal part of the seventh. Eyes black, ocular tubercles and ocelli absent. Beak dark and short, 0.18 mm. long, extending to the mesocoxæ.

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[18] Burrows's unpublished manuscript.

Prothorax not plainly set apart from the head. Thorax has no distinct lobes, but has two patches of dark coloration on the dorsal part, as shown in the illustration. Legs slightly hirsute; also there are from a few to eight flabellæ on each one; femora dark, tarsi dark, tibia light brown. Legs all normal in length. Femora especially well developed, the cephalic pair the largest.

Abdomen dark brown, with black coloration in the region stippled in the drawing. Whole body sparsely covered with flabellæ. Honey-tubes black, imbricated as wide at the base as long, tuberculate, 0.09 mm. long, or a little more than half the length of the tarsi. Style black, knobbed, mounted with five or six setaceous hairs, which are on prominent tubercles. Length, 0.09 mm., being equal to the honey-tubes in length. Total length of the body, 1.50 mm.

This form was taken May 4, from grass sweepings; consequently its host-plant and habits are not exactly known. Since only one was taken, and the coloration of it not well noted, the description may not be exact.

Callipterus genevei, n. sp. Plate VII, fig. 45.

Head pale yellow. Antennæ dusky, imbricated, and almost bare; length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.46 mm.; IV, 0.34 mm.; V, 0.28 mm.; VI, 0.18 mm.; VII, 0.19 mm.; total length, 3.60 mm., or nearly equal to the body in length. Sensoria circular; ten to twelve on the third joint, none on the fourth, the usual distal one on the fifth, one surrounded with a fringe of fine hairs at the distal end of the sixth. Eyes red; ocular tubercles prominent; ocelli normal. Beak dark at the distal end, remainder pale yellow. Length, 0 27 mm., extending to the mesocoxæ.

Prothorax pale yellow; thorax of the same color. Wings hyaline, veins dark and bordered with a light smoky color, wider on each side than the veins. Stigmal vein obsolete at the base. Stigma, 0.12 mm. broad and 0.45 mm. long. Total wing expansion, 4.89 mm. Legs brownish yellow, hirsute, and normal in length.

Abdomen brown, with black markings situated at the base of capitate hairs, which are on small tubercles, as shown in the figure. Honey-tubes are concolorous with the abdomen, widest at their bases, and 0.07 mm. long, or about half the length of the tarsi. Style knobbed with a large elongate knob, hirsute, having some long, conspicuous hairs, as shown in the figure; a characteristic tubercle is near the distal end mounted with a single hair. Length, 0.23 mm., or about three times the length of the honey-tubes. Total length of the body, 3.84 mm.

This form was taken on the wing, May 18; consequently its habitat was not noted. This species is named in honor of Miss Geneva Hunter.

Callipterus asclepiadis Monell. Plate IX, fig. 56.

This insect has not been described by me before the coloration faded; consequently I cannot give the coloration as when collected. The entire body seems to be greenish yellow. Antennæ nearly bare; length of segments: I, 0.07 mm.; II, 0.05 mm.; III, 0.25 mm.; IV, 0.19 mm.; V, 0.21 mm.; VI, 0.12 mm.; VII, 0.28 mm.; total length, 1.17 mm., extending to the base of the honey-tubes. Sensoria circular; about eight on the third joint, none on the fourth, the usual distal one on the fifth, one large with some small ones on the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli present but not conspicuous. Beak 0.45 mm. long, extending about two-thirds of the way from the pro- to the mesocoxæ.

Prothorax short with moderate-sized tubercles. Thorax well developed. Wings brownish; some irregular markings were present when collected but have now faded away. Veins frail. Stigma, 0.14 mm. wide and 0.63 mm. long. Total wing expansion, 6.00 mm. Legs hirsute, normal in length.

Abdomen normal in appearance; honey-tubes, 0.19 mm. long, or about twice the length of the tarsi, incrassate, widest near the base. Style concolorous, slightly hirsute, knobbed, 0.12 mm. long, or a little more than half the length of the honey-tubes. Total length of the body, 1.45 mm.

This form was taken November 1, on the milkweed (*Asclepiadis* sp.?). It is gregarious in habit and colonizes the ventral side of the leaves.

Callipterus bellus Walsh. Plate VII, fig. 44.

Head yellowish brown, and very small in proportion to the prothorax, being somewhat overlapped by the latter, making the head appear about twice as broad as long. Antennæ nearly bare, pale, with distal parts of segments three to six black; length of segments: I, 0.09 mm.; II, 0.05 mm.; III, 0.59 mm.; IV, 0.43 mm.; V, 0.41 mm.; VI, 0.23 mm.; VII, 0.36 mm.; total length of antennæ, 2 mm., extending near to the base of the style. Sensoria circular and few, about five on the third joint; the usual one on the fifth near the distal end; a small elongate cluster at the union of the sixth and seventh. Eyes pale red; ocular tubercles present and small. Ocelli present and inconspicuous. Beak dark, extending to the procoxæ, being 0.32 mm. long.

Prothorax extra large. Central part of the same color as the head, but the lateral borders black, which color extends caudad and apparently to the distal end of the wings. Lateral tubercles small, and on the boundary of the pro- and mesothorax. Thorax black; wings hyaline, but black along the costal and subcostal areas, extending to the apex of the wing as shown in the illustration. Discoidals frail and dark brown. Stigma, 0.9 mm. long and 0.14 mm. broad. Total wing expansion, 7.25 mm. Legs black and hirsute, especially the tibia.

Abdomen brownish, anal lobes quite prominent and hirsute, extending midway on the knob of the style. Honey-tubes cylindrical, concolorous with the abdomen, 0.05 mm. long, or about one-third the length of tarsi. Style concolorous with the abdomen, hirsute and spinous, knobbed, 0.32 mm., being six times the length of the honey-tubes, or twice the length of the tarsi. Total length of the body, 2.44 mm.

This form was taken June 14 on the oak (*Quercus rubra*). It is sporadic in habit. Only a few specimens were on the ventral side of each leaf where found.

Callipterus, n. sp. Plate XIV, fig. 76.

Head brownish yellow. Antennæ slightly hirsute, black at the distal ends, except the first, second and seventh joints;

length of joints: I, 0.07 mm.; II, 0.07 mm.; III, 0.63 mm.; IV, 0.36 mm.; V, 0.34 mm.; VI, 0.18 mm.; VII, 0.14 mm.; total length, 1.80 mm., or about equal in length to the body. Sensoria circular and rather large but indistinct; about seven to the third joint, not close together, absent on the fourth joint, the usual one near the distal end of the fifth joint, and about four small and one large at the base of the unguis. Eyes red; ocelli red. Beak concolorous with the head, reaching to the mesocoxæ, 0.27 mm. long.

Prothorax brownish yellow, small in proportion to the head. Thorax brownish yellow. Wings hyaline, veins slender, light brown and curving, each ending in a brownish splotch, cubitus obsolete at the base. Stigma light brown, 0.45 mm. long and 0.109 mm. wide; total wing expansion, 0.90 mm. Legs rather long in proportion to the body, tibia slightly hirsute, all concolorous with the body.

Abdomen brownish yellow. Honey-tubes as long as wide at the base, being 0.05 mm. long, or half the length of the tarsi. Style knobbed, concolorous with the abdomen, hirsute, and 0.128 mm. long, being nearly twice as long as the honey-tubes; anal lobes prominent. Entire length of the body, 1.72 mm.

This form was taken in July, on the elm (*Ulmus americana*). It is somewhat gregarious, but not very noticeable. Mostly found on the ventral side of the leaves.

Callipterus sp.? Plate VII, fig. 32.

Head dark green. Antennæ slightly hirsute; distal end of the third, fourth, fifth and sixth dark, remainder concolorous or lighter than the head; length of segments: I, 0.09 mm.; II, 0.09 mm.; III, 0.52 mm.; IV, 0.45 mm.; V, 0.36 mm.; VI, 0.14 mm.; VII, 0.10 mm.; total length, 1.75 mm., extending nearly to the base of the honey-tubes. Sensoria circular; five or six on the third joint, none on the fourth, the usual distal one on the fifth, and a distal one about the same size on the sixth; the usual group of smaller ones seem to be absent in this case. Eyes black; ocular tubercles prominent; ocelli present but not conspicuous. Beak dusky, 0.45 mm. long, extending to a point midway between the pro- and mesocoxæ.

Prothorax dusky, caudal half with several small tubercles, about twenty; some of the smaller ones on the lateral sides are mounted with a single spinous hair. Thorax bluish green; wings pellucid and smoky; veins black margined with black, smoky borders one-half to two-thirds as wide as the stigma. Stigma concolorous with the vein borders; 0.19 mm. broad and 0.72 mm. long. Sometimes the costal cell is also colored with the same coloration as the stigma. Total wing expansion, 6.52 mm. Legs dark green or brown, which is not uniform throughout their length; the distal end of the hind tibia being the lightest in color. All hirsute and normal in length except the hind tibia, which is long.

Abdomen bluish green, somewhat hirsute, but not armed with hairs as is the apterous form. Instead of the spines are small tubercles. Dorsal part of the abdomen marked with about seven dark transverse bars. Each lateral margin has the same color in the form of spots. Honey-tubes dusky, clavate, with wide-open mouths. Length, 0.09 mm., equal to the style in length, but not half as long as the tarsi. Style globular, hirsute, light in color, 0.09 mm. long. Equal in length to the tarsi. Anal lobes prominent, hirsute, a little larger than the knob of the style. Total length of the body, 2.08 mm. This form was taken on the elm (*Ulmus americana*). The winged forms appeared about May 20. It is gregarious in habit and colonizes the ventral side of the leaves. A variation of this species is shown on plate VII, figure 46.

Tribe APHIDINI.

Antennæ moderately long, hardly ever longer than the body. Frontal tubercles rarely present, and very conspicuous when present. Seven-jointed (except in *Mastopoda*). Eyes with ocular tubercles. Beak moderately long. Legs moderately long and well developed. Abdomen never very long, compact, and somewhat rounded caudally. Honey-tubes generally cylindrical or slightly incrassate, rarely tuberculate or obsolete. Style conical, generally well developed, rarely obsolete. This tribe is gregarious, and is found on the leaves, tender stems, and, in rare cases, on the roots of plants.

Genus **Hyalopterus** Koch.[19]

Vertex flat. Antennæ about as long as the body. Sensoria small and irregularly placed. Eyes dark red. Beak short.

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[19] No representative in text.

Wing hyaline, long, with slender veins. Legs moderately long. Honey-tubes short, cylindrical, narrow, not longer than the style. Latter small, pointed, and curved upwards.

Genus **Mastopoda** Oestlund.[19]

Antennæ as long as the body, six-jointed, the third and setaceous sixth being the longest, on no frontal tubercles. Eyes dark red. Beak moderately long. Wings rather short and broad, deflexed in repose; venation typical. Legs rather long, with the tarsi and claws atrophied. The tibiæ are truncate at the tip and furnished with a membrane, the structure of which seems to be similar to that of Diptera, as they are able to walk with ease not only on the perpendicular but also on the under surface of a glass plate. The upper side of the tibial tip is furnished with a small tubercle, which probably represents the claws.

Genus **Sipha** Passerini.

This genus resembles *Aphis*, with the exceptions of having longer wings (see figure) in proportion to the body, and shorter antennæ, being but six-jointed and extending but little beyond the thorax.

Genus **Aphis** Linn.

Antennæ usually a little longer than the body. Frontal tubercles none or very rudimentary. Eyes red or black. Beak variable in length. Wings rather short and broad, deflexed in repose, venation typical. Legs moderately long. Abdomen short and broad, rounded or obtuse behind. Honey-tubes of moderate length, cylindrical or sometimes slightly incrassate, very rarely obsolete. Style short, thick, conical, and usually prominent.

Genus **Siphocoryne** Passerini.[19]

Antennæ on no frontal tubercles, and shorter than the body; third joint with many sensoria, which causes it to appear serrate on the ventral side; seventh joint not longer than the third. Beak short to moderately long. Wings rather short and broad, deflexed in repose. Legs moderately long. Honey-tubes moderately long but sometimes extending a little caudad of the distal end of the style. Style in our species apparently short but in British species long.

Genus **Rhopalosiphum** Koch.

Vertex flat or slightly convex. Antennæ about as long or longer than the body, on remote small and inconspicuous frontal tubercles. Beak generally moderately long, but variable in length. Prothorax with no lateral tubercle. Wings moderately long, venation normal. Legs short and robust. Honey-tubes incrassate, or clavate. Style conspicuous, variable in size, sometimes small and slender, but often large.

Sipha rubifolii Thomas. Plate VIII, fig. 50.

Head black; antennæ light brown, imbricated. Length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.308 mm.; IV, 0.09 mm.; V, 0.128 mm.; VI, 0.19 mm.; total length, about 0.9 mm., extending about the length of the style beyond the abdomen. Sensoria circular, rather large; number on the third joint, two to six in a row, one at the distal end of the fourth, six small and one large at the distal end of the fifth. Eyes black; ocular tubercles of a reddish tinge. Ocelli prominent. Beak dark brown, 0.36 mm. in length, and extends a little beyond the mesocoxæ.

Prothorax dark brown, cephalic border black; thorax black; wings hyaline, veins light brown and frail. Stigma very light brown, 0.54 mm. long and 0.18 mm. broad. Total wing expansion, 3.96 mm. Legs light brown, slightly hirsute; tarsi and femora a little darker than the tibia, which is very long in proportion to the remainder of the leg.

Abdomen light brown; honey-tubes imbricated, concolorous to the abdomen, almost cylindrical, and 0.145 mm. long. Style concolorous with the abdomen, conical, hirsute, and 0.09 mm. long, being about a third the length of the honey-tubes. Average length of the body, 0.90 mm.

This form was taken May 7, at Girard, on the cultivated blackberry (*Rubus villosus?*). It is gregarious on the ventral side of the leaves.

In Thomas's description of this aphis,[20] he did not have enough material to thoroughly satisfy his curiosity, it seems. Particu-

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[20] Thomas, Rept. Ent. Ill., 8: 121, 122, 1880.

larly the wing venation was not clear to him. On account of abundance of material, I can say that his statements were all true, except the third discoidal of the cubitus in his specimen must have been slightly abnormal. I think that the elimination of one joint in the antennæ is brought about by the non-division of the third and fourth, because in all aphids that I have examined the winged form has a constant distal sensorium on the fifth segment. In this form this is present on the fourth, which, together with the arrangement of the sensoria on the distal end of the fifth, which corresponds to the normal arrangement of the sixth segment in the genus *Aphis*, furnishes proof that the fourth and fifth joints of this form correspond to the fifth and sixth in *Aphis*. Furthermore, I have an example of the gradual elimination of one joint by the coalition of the third and fourth. It is shown in plate XXII, figure 100, and described as a transitional form.

Drepanosiphum acerifolii THOMAS. Plate XX, fig. 94.

Head brownish yellow. Antennæ paler than the head, except the distal end of the third, both ends of the fourth, fifth, sixth, and the base of the seventh, which are all black; all slightly hirsute; length of joints: I, 0.21 mm.; II, 0.05 mm.; III, 0.86 mm.; IV, 0.59 mm.; V, 0.55 mm.; VI, 0.13 mm.; VII, 0.90 mm.; total length, about 3.17 mm. (These measurements are not constant.) Sensoria circular; of the third, eight to eleven, somewhat large, raised and in a single row, mostly on the basal half of the segment. The usual large sensoria present near the distal end of the fifth joint. Three large sensoria in a longitudinal row near the distal end of the sixth joint. Eyes red; ocular tubercles present. Ocelli prominent, with a dark border. Beak dark, 0.36 mm. long, and extending nearly to the mesocoxæ.

Prothorax as wide as the head, pale black. Thorax brownish yellow, sclerites sometimes with dark longitudinal centers. Wings hyaline in places, venation frail, greenish yellow; stigma somewhat mottled, ranging from a clear color to a dark brown; in length, 0.59 mm., and breadth, 0.21 mm. All the veins have a smoky border as shown in the illustration. Total wing expansion, 4.70 mm. Legs pilose, pale brown, and small in proportion to the body.

Abdomen brownish yellow, honey-tubes dark, incrassate, and somewhat funnel-shaped at the end; length, 0.25 mm. Style concolorous with the abdomen, hirsute, knobbed, and 0.07 mm. long.

This form was taken on the Soft maple (*Acer dasycarpum*), during the middle of May. They endured weather which froze off the ends of their antennæ. They are both sporadic and gregarious in habit, and may be found on the terminal buds, but more frequently on the ventral side of the leaves.

Aphis ribis, n. sp. Plate XVI, fig. 82.

Head dark. Antennæ dark, much imbricated, and with but few hairs; length of segments: I, 0.05 mm.; II, 0.07 mm.; III, 0.27 mm.; IV, 0.23 mm.; V, 0.19 mm.; VI, 0.12 mm.; VII, 0.28 mm.; total length, 1.30 mm, extending to the central part of the abdomen. Sensoria circular, six in a row on the third joint, four in a row on the fourth, the usual distal one on the fifth, six small and one large one at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli normal. Beak dusky, 0.41 mm. long, extending midway between the pro- and mesocoxæ.

Prothorax dark, lateral tubercles broader than long. Thorax dark, wings pellucid; veins with a very slight smoky border. Stigma black, 0.63 mm. long and 0.13 mm. broad. Total wing expansion, 3.02 mm. Legs of a nearly uniform brown, tibia lighter except the distal end.

Abdomen dark green, with four pairs of lateral black spots. Near the caudal end on each side the style is a lateral tubercle about twice as long as broad. Honey-tubes black, with imbrications like those on the antennæ, cylindrical, and 0.19 mm. long, being twice the tarsi in length and extending to near the base of the style. Style conical; distal half black, the color extending to the base along the lateral margins. The enclosed part is of a lighter color. Armed with numerous small spines and some setaceous hairs. Length, 0.18 mm., or about equal to the honey-tubes. Total length of the body, 2.37 mm.

This form was taken May 17, on the cultivated currant (*Ribes rubrum*, var. *subglandulosum*). It is gregarious in habit and colonizes the ventral side of the leaves, causing them to curl, which forms a pseudogall of protection.

Aphis rumicis Linn. Plate XI, fig. 67.

Head black. Antennæ dark, imbricated, and nearly bare; length of segments: I, 0.07 mm.; II, 0.07 mm.; III, 0.37 mm.; IV, 0.23 mm.; V, 0.21 mm.; VI, 0.12 mm.; VII, 0.23 mm.; total length, 1.30 mm., extending to the central part of the abdomen. Sensoria circular and unequal in size; eight to ten on the third joint, none on the fourth, the usual distal one on the fifth, and one large one at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli not very conspicuous. Beak dark, 0.54 mm. long, extending to the mesacoxæ.

Prothorax brown, narrow in length and slightly overlapped by the thorax, which partly hides the lateral tubercles. The thorax is black and arched. Wings pellucid, discoidals black, costal and subcostal dark brown, the latter bordered caudad with a light brown line. Stigma dark, 0.16 mm. broad and 0.66 mm. long; total wing expansion, 6.88 mm. Legs dark brown, hirsute, and normal in length.

Abdomen dark; honey-tubes black, imbricated, cylindrical, and 0.14 mm. long, being equal to the tarsi in length. Style black, hirsute, and 0.16 mm. long, being but little longer than the honey-tubes. Total length of the body, 1.90 mm.

This form was taken May 5, on dock (*Rumex crispus*). It is gregarious and colonizes the terminal stems. The colony gives the parts a black appearance, on account of their proximity to each other.

Aphis, n. sp. Plate XIV, fig. 75.

Head black. Antennæ black with but few hairs, and imbricated; length: I, 0.05 mm.; II, 0.05 mm.; III, 0.25 mm.; IV, 0.18 mm.; V, 0.16 mm.; VI, 0.10 mm.; VII, 0.19 mm.; total length, 0.99 mm., extending to the mesocoxæ. Sensoria circular, unequal in size, and numerous, sixteen to thirty on the third joint, eight to ten on the fourth, the usual distal one and sometimes two or three others on the fifth; a cluster of small ones and a large one at the distal end of the sixth. Eyes black; ocelli conspicuous, bordered with black; ocular tubercles prominent. Beak dark, 0.45 mm. long, extending half-way to the mesocoxæ.

Prothorax dark, lateral tubercles prominent, and as broad as long. Thorax black. Wings subhyaline, veins medium sized and dark. Stigma dark brown, 0.10 mm. wide and 0.34 mm. long. Total wing expansion, 5.80 mm. Legs hirsute and normal. Tarsi, distal ends of tibia and femora dark, rest lighter in color.

Abdomen dark green; lateral tubercles at the base of the abdomen not as large as those on the prothorax. There are two of these, one on each side of the abdomen. Honey-tubes black, imbricated, cylindrical; length, 0.19 mm., or about one-fifth of their length longer than the tarsi, extending nearly to the base of the style. Latter black at its distal half, the color extending to the base along the margins, remainder concolorous with the abdomen; slightly hirsute and armed with short spines. Length, 0.18 mm., or nearly to the honey-tubes in length. Total length of the body, 1.81 mm.

This form was taken April 25, on the wild gooseberry (*Ribes gracile*). It is gregarious and colonizes the ventral side of the leaves, causing them to curl. It is similar to the form that is found on the terminal stems, but has more sensoria, lateral tubercles are not as conspicuous on the abdomen, and no color marks here, as the other form has.

Aphis aubletia, n. sp. Plate XII, fig. 68.

Head black. Antennæ dusky, imbricated, and bare; length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.21 mm.; IV, 0.128 mm.; V, 0.14 mm.; VI, 0.128 mm.; VII, 0.22 mm.; total length, 0.90 mm., extending one-third its length caudad of the abdomen. Sensoria rather large, circular, and nearly in rows; seven on the third joint, three on the fourth, two on the fifth, and one large one with a cluster of small ones at the distal end of the sixth. Eyes black; ocular tubercles have a reddish tinge; ocelli not very prominent, bordered with a reddish tinge. Beak light brown, extending to the metacoxæ, being 0.54 mm. long.

Prothorax dusky, cephalic border black. Thorax black, membrane dusky. Wings stippled with irregular dark spots, which gives them a dark cast. All veins robust, and all equal in breadth except the subcostal, which is broader. Second discoidal of the hind wing sometimes forked, as shown in the illustration. Total wing expansion, 4.30 mm. Legs stout, hirsute, and pale brown; tarsi and distal end of the tibia dusky.

Abdomen light brown in some species, dusky in others. Honey-tubes concolorous with the abdomen, cylindrical, and 0.21 mm. long, or twice the length of the tarsi. Style black on distal half, hirsute, and 0.128 mm. long, or half the length of the honey-tubes. Total length of the body, 1.31 mm.

This form was taken in May, on the verbena (*V. aubletia*). It is gregarious and colonizes all the above-ground plant.

Aphis, n. sp. Plate IX, fig. 52.

Head black. Antennæ black, bare, and imbricated; length of segments: I, 0.07 mm.; II, 0.07 mm.; III, 0.28 mm.; IV, 0.18 mm.; V, 0.18 mm.; VI, 0.09 mm.; VII, 0.34 mm.; total length, 2.15 mm., extending a third of the way caudad on the abdomen. Sensoria circular and unequal in size; twenty to twenty-five on the third joint, three in a row on the fourth, the usual one near the distal end of the fifth, six small and unequal in size and one large at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli conspicuous. Beak dark, 0.72 mm. long, the distal end of the second joint reaching the abdomen.

Prothorax dark; lateral tubercles prominent; thorax dark; wings pellucid, venation medium in width, and dark. Stigma dark, 0.14 mm. broad and 0.54 mm. long. Total wing expansion, 6.80 mm. Legs a little long in proportion to the body. Tarsi, distal end of the tibia and femora black, remainder lighter in color.

Abdomen brownish green, a black spot on the lateral margin of each tergum, also two black transverse bars caudad the honey-tubes. Six lateral tubercles on each lateral margin. The first one at the base of the abdomen and the one caudad the honey-tube as large as the lateral tubercle on the prothorax, remainder smaller in size. Honey-tubes black, imbricated, almost cylindrical, broadest at the base; the distal end has a very narrow expanding rim. Caudad these is a black patch on each side of the abdomen. Cephalad each is a semicircular light band extending caudad the base. Length, 0.25 mm., or twice the length of the tarsi, extending to the base of the style. Style black at the distal half, this color extends cephalad along the margins, remainder concolorous with the abdomen. All hirsute and armed with short spines. Length, 0.18 mm., or a little more than half the length of the honey-tubes. Total length of the body, 1.99 mm.

This form was taken July 12, on the dorsal side of the tenderest leaves of burdock (*Arctium lappa*). It is gregarious in habit, but not very numerous. Its colonization of the burdock lasted only a short time this last summer.

Aphis, n. sp. Plate X, fig. 57.

Head black. Antennæ dark, imbricated, and bare; length of segments: I, 0.03 mm.; II, 0.05 mm.; III, 0.25 mm.; IV, 0.18 mm.; V, 0.12 mm.; VI, 0.10 mm.; VII, 0.37 mm.; total length, 1.25 mm., or about the length of the seventh joint shorter than the body. Sensoria circular, giving the antennæ an uneven appearance; about thirty on the third, ten on the fourth, the usual distal one on the fifth, and one equal to this in size at the distal end of the sixth, with four or five smaller ones. Eyes black, with a purple tinge; ocular tubercles prominent; ocelli prominent. Beak dark, 0.36 mm. long, extending midway between the pro- and mesacoxæ.

Prothorax short and dark. Thorax black and well developed. Wings subhyaline, venation dark, discoidals quite straight. Stigma not as dark as the veins, 0.54 mm. long and 0.12 mm. broad. Total wing expansion, 5.12 mm. Legs slightly hirsute; tarsi, distal part of the tibia, and all but the proximal part of the femora black.

Abdomen dark green. Honey-tubes black, incrassate, extending a little caudad the base of the style, 0.13 mm. long, being a little longer than the style or tarsi. Style grayish in color, having a few long setaceous hairs, and armed with small spines. Length, 0.19 mm., or about equal to the tarsi in length. Total length of the body, 1.63 mm.

This form was taken June 6, on the honeysuckle (*Lonicera sempervirens* (?)). It is gregarious in habit and colonizes the ventral side of the leaves. The colonies have not been very prosperous here while this collecting has been done.

Aphis, n. sp. Plate XII, fig. 71.

Head black. Antennæ black, imbricated, bare with the exception of a few spinous hairs; length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.25 mm.; IV, 0.18 mm.; V, 0.16 mm.; VI, 0.10 mm.; VII, 0.29 mm.; total length, 1.10 mm., extending a little beyond the thorax. Sensoria circular, nearly uniform in size; from eight to ten on the third joint, situated nearly in a straight row, about four in a row on the fourth, the usual one near the distal end of the fifth, and a cluster of seven not uniform in size on the distal end of the sixth. Eyes black; ocular tubercles not prominent; ocelli normal. Beak dark, extending to the mesocoxæ, being 0.54 mm. long.

Prothorax dark, cephalic margin black, lateral tubercles broader than long. Thorax black, membrane pale brown. Wings nearly hyaline, veins black, bordered with a very light smoky tinge, which is about twice as broad as the veins. Stigma light brown, 0.12 mm. broad and 0.68 mm. long. Total wing expansion, 6.80 mm. Legs hirsute, articulations dark, except the coxal ones, which are pale yellow.

Abdomen brownish green, with about four black spots along the lateral margins, also the distal segment ventrad the style is black. One lateral tubercle on each side the first abdominal segment, and one on each side the abdominal segment caudad the honey-tubes. Honey-tubes cylindrical, black, imbricated, and 0.18 mm. long. Style black and hirsute, equal to the honey-tubes in length, or 0.18 mm. Total length of the body, 1.80 mm.

This form was taken April 21, on the wild gooseberry (*Ribes* sp.?). It is gregarious, colonizing the petioles and tender growing stems of the plant. The young apterous forms are green, thus being protected by coloration with the host-plant; yet they are not entirely exempt from parasitic enemies on this account, for whole colonies are often exterminated by them in a few days after being attacked.

Aphis nerii Fonsc. Plate VIII, fig. 48.

Head black. Antennæ yellowish black, bare, and imbricated; length of segments: I, 0.07 mm.; II, 0.05 mm.; III, 0.28 mm.; IV, 0.19 mm.; V, 0.19 mm.; VI, 0.10 mm.; VII, 0.27 mm.; total length, 1.05 mm., extending to the abdomen. Sensoria circular, large and unequal in size; about nine on the third joint, none on the fourth, the usual distal one on the fifth, six small and one large one at the distal end of the sixth. Eyes black; ocular tubercles reddish; ocelli normal. Beak dark, 0.39 mm. long, extending to the mesocoxæ.

Prothorax dark yellow; lateral tubercles present but not very prominent. Thorax dark yellow; wings pellucid, veins dark brown bordered with a faint smokiness. Stigma dark, 0.07 mm. in breadth and 0.12 mm. long. Total wing expansion, 5.80 mm. Tarsi and distal end of the tibia black, remainder brownish yellow. All slightly hirsute and normal in length.

Abdomen brown, with a marginal row of three or four black spots, one at the base of each honey-tube, and some transverse markings along the median line, as shown in the illustration. Honey-tubes imbricated, cylindrical, and black, except a small semicircular patch at the cephalic part of the base which is of a light yellow. Length, 0.19 mm., or about twice as long as the tarsi. Style hirsute and imbricated. It has a black distal half, the color extending along the margin to its base; the remainder is light yellow in color. It is 0.10 mm. long, or about one-half the length of the honey-tubes. Total length of the body, 2.00 mm.

This form was taken November 1, on the milkweed (*Asclepias* ——) and oleander (*Nerium oleander*). It is gregarious and colonizes the ventral side of the leaves. Fitch has named this louse *asclepiadis*, but it is doubtless the same form which Fonslecomb named *nerii*. (Thomas, Rept. Ent. Ill., 8 : 95, 1880.) For a variation in form, see plate IX, figure 72.

Aphis sambucifolia Fitch. Plate XIX, fig. 91.

Head black. Antennæ brownish black and hirsute; length of segments: I, 0.09 mm.; II, 0.09 mm.; III, 0.34 mm.; IV, 0.23 mm.; V, 0.23 mm.; VI, 0.12 mm.; VII, 0.39 mm.; total length, 1.50 mm., extending to the abdomen. Sensoria circular and numerous; about twenty-six on the third segment, twelve on the fourth, six on the fifth, and a cluster of very small ones mounted with short hairs at the distal end of the sixth. Eyes black with a slight tinge of red; ocular tubercles prominent; ocelli normal. Beak blackish at the distal end, 0.9 mm. long, extending to the mesocoxæ.

Prothorax is black and short, having two pairs of lateral tubercles, the caudal pair not conspicuous; the cephalic pair broader than long. Thorax is black and arched. Wings pellucid with a brownish cast; veins dark brown with narrow smoky borders. Stigma, 0.72 mm. long and 0.09 mm. wide.

Total wing expansion, 6.70 mm. Prothoracic legs light brown, femora and tarsi of mesa- and metathoracic legs black, tibiæ light brown.

Abdomen slightly hirsute, grayish, with about eight indistinct transverse black bars, and a black patch at the base of each honey-tube. Along the lateral margin are eight lateral tubercles. The honey-tubes are black, slightly clavate, and 0.36 mm. long, or about three times the length of the tarsi. Style hirsute, all black except a small semicircle at the base, 0.11 mm. long, or about one-third as long as the honey-tubes. It is bluntly rounded distally.

This form was taken June 15. It is gregarious in its habits, colonizing the terminal leaves of the elder (*S. canadensis*). It is similar in its work to the *Chaitophorus negundinis*, in that it is attended by ants and secretes so much honeydew that the growth of the plant is finally checked for a time. It has previously been considered that the *A. sambuci* Linn. and the *A. sambucifolia* Fitch were synonymous, but with this form and that of figure 60 at hand, a difference is apparent.

Aphis cratægifolia Fitch. Plate XIII, fig. 74.

Head black. Antennæ black, slightly hirsute, first joint glabrous; length of joints: I, 0.036 mm.; II, 0.05 mm.; III, 0.27 mm.; IV, 0.16 mm.; V, 0.145 mm.; VI, 0.17 mm.; VII, 0.31 mm.; total length, 1.04 mm., extending near to the center of the abdomen. Sensoria circular and moderately small; about fifteen on the third joint, seven nearly in a row on the fourth, one small near the center and one large near the distal end of the fifth, and a cluster of four or five at the distal end of the sixth. Eyes dark red; ocular tubercles of a lighter red, and equal in size to the lateral tubercles. Distal half of the second segment of the beak black, remainder brownish yellow. It extends to the mesocoxæ, being 0.45 mm. long.

Prothorax brownish black; sclerites of the thorax black, membrane dusky. Wings hyaline, veins slender and slightly dusky. Subcostal and first discoidal slightly dusky until near the base of the stigma, where subcostal becomes more dusky, especially along the caudal margin to the distal end of the stigma. The latter is dusky gray, 0.67 mm. long and 0.127 mm. wide. In many specimens the cubitus is only once branched, and, where twice branched, quite near the distal end of the vein, as shown in the illustration; total expansion, 5.80 mm. Legs black except at the proximal ends, which are lighter in color. Coxæ are black.

Abdomen mostly dusky green; two transverse dark bands on the first two segments cephalad the honey-tubes. Also three or four dark patches along the margins cephalad the honey-tubes. Latter dark, incrassate, constricted near the apex, expanding again at apex to the original diameter, being 0.18 mm. long. Style hirsute, dark except at the base, which is concolorous with the abdomen, about 0.10 mm. long, or equal to tarsi or half the honey-tubes in length. Entire body, 1.45 mm. long.

This form is found on the hawthorn (*Cratægus tomentosa*). It hatches from the egg March 15, is gregarious in habit and quite numerous, colonizing both sides of the leaves. The dorsal side was affected in July and greatly corrugated, but in October the form was more sporadic on the ventral side of the leaves.

Aphis brassicæ Linn. Plate X, fig. 61.

Head blackish. Antennæ dark, imbricated, and slightly hirsute; joint I, 0.05 mm.; II, 0.07 mm.; III, 0.70 mm.; IV, 0.28 mm.; V, 0.32 mm.; VI, 0.14 mm., and joint VII, 0.54 mm. long. Total length, 2.10 mm., extending twice the length of the honey-tubes beyond the abdomen. Sensoria of third joint circular, of moderate size, irregularly placed, and about fifty in number. One sensoria near distal end of fifth joint. Six small and one large sensorium on sixth joint at the union of the seventh. Total length of antennæ, 1.81 mm. Eyes black. Ocelli prominent. Beak darker at the distal end than near the base; it extends to the second coxa and is 0.36 mm. long.

The prothorax is dark, especially along the margins. Thorax is black. Wings are hyaline, venation brownish, with a border of a smoky tinge, also rather coarse except stigmal vein, which is also clearer in color. Stigma is dark brown, 0.90 mm. long and 0.16 mm. broad. Total wing expansion, 11.60 mm. Legs dark brown, lightest at the proximal part of the femur. Metathoracic legs smaller than the others.

Abdomen greenish gray, and pulverulent. When this pulverulency is removed the aphis is of a greener appearance; also a marginal row of black spots, of which there are four on each side, are more distinct. Extending across the abdomen are about seven or eight dark transverse bars. The honey-tubes are dark, incrassate, and 0.10 mm. long, not extending to the base of the style. The style is dark, hirsute, acute, and 0.12 mm. long by 0.12 mm. wide at the base. Total length of the body, 1.90 mm.

This species was taken from hotbed cabbage, April 23. Later in the season it was found on a great many other plants of the same genus. It is gregarious, and colonizes both sides of the leaves and the tenderest parts of the remainder of the plant.

Aphis cardui Linn. Plate XVI, fig. 83.

Head brownish black. Antennæ black; length of segments: I, 0 mm; II, 0 mm; III, 0.56 mm.; IV, 0.38 mm.; V, 0.23 mm.; VI, 0.12 mm.; VII, 0.48 mm. About twenty-four circular sensoria on the third joint. Eyes dark, tinged with red. Beak, 0.97 mm. long, extending to the caudal boundaries of the mesocoxæ.

Prothorax short, brownish yellow, with a cephalic black border. Thoracic sclerites mostly black, with membrane brownish yellow. Wings hyaline, veins frail; stigma, 0.64 mm. long and 0.16 mm. broad; total wing expansion, 6.48 mm. Legs: Distal half of femora dark brown, becoming paler near the proximal end; tibia dark brown at the distal end and paler proximally; tarsus dark brown.

Abdomen varies in color with the age. Normally there is a dark quadrate patch on the dorsum in the region of the honey-tubes. There are also about three dark patches on the lateral margins of the abdomen; the segments caudad of the honey-tubes have transverse black bands. Honey-tubes black, clavate, and 0.34 mm. long. Style has distal half and lateral borders black, remainder brownish yellow; total length, 0.14 mm., being as broad at the base as it is long. Total length of body, 2.22 mm.

This form was taken June 8. It is gregarious on the common thistle (*Cardus lanceolatus*). The colony shows a variegated appearance in color. The young are quite green and the old are nearly black.

Aphis vitis Scopoli. Plate XI, fig. 65.

Head dark brown. Antennæ black except at the distal ends of the third, fourth, fifth and sixth segments, which are lighter in color; nearly bare and deeply imbricated; length of segments: I, 0.09 mm.; II, 0.07 mm.; III, 0.34 mm.; IV, 0.23 mm.; V, 0.22 mm.; VI, 0.10 mm.; VII, 0.36 mm.; total length, 1.40 mm., generally extending to the distal end of the abdomen. Sensoria circular, six in a row on the third joint, four in a row on the fourth, the usual one near the distal end of the fifth, six small of uniform size and two large ones at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli present but not very conspicuous. Beak black, 0.45 mm. long, extending to the mesocoxæ.

Prothorax dark brown; lateral tubercles prominent. Thorax dark brown to black; wings pellucid; veins brownish, rather frail. Stigma black, 0.72 mm. long and 0.14 mm. broad. Total wing expansion, 5.35 mm. Legs normal, black, very slightly hirsute; central part of the tibia a little the lightest in color.

Abdomen dark brown; honey-tubes black, imbricated, and cylindrical; length, 0.32 mm., or about five times the length of the tarsi, extending generally to the tip of the style. Style black, hirsute, conical, and 0.10 mm. long; equal in length to the tarsi, or about one-fifth the length of the honey-tubes.

This form was taken July 9, on the cultivated grape. It is gregarious, and colonizes the tender growing stems and the dorsal side of the leaf.

Aphis gossypii Glov. Plate XII, fig. 69.

Head and antennæ black; latter distinctly imbricated and almost bare; length of segments: I, 0.05 mm.; II, 0.05 mm.; III, 0.19 mm.; IV, 0.14 mm.; V, 0.14 mm.; VI, 0.09 mm.; VII, 0.23 mm.; total length, 0.80 mm., extending to the honey-tubes. Sensoria circular, four or five on the third joint, none on the fourth, the usual distal one on the fifth, and six of unequal size on the distal end of the sixth. Eyes black; ocular tubercles normal; ocelli normal. Beak dark, the distal segment the darkest; length, 0.63 mm. It extends to the abdomen.

The cephalad part of the prothorax is black. The caudal half is pale brown, with the exception of two black spots near the lateral tubercles. The latter are normal. Thorax black; wings nearly hyaline, veins dark brown and frail. Stigma, 0.09 mm. broad and 0.45 mm. long. Total wing expansion, 4.02 mm.

Abdomen pale brown; one lateral tubercle near the thorax; four black spots along the margin of the abdomen not shown in the illustration. Apical segment also black. Honey-tubes imbricated, nearly cylindrical, being a little wider at the base than at the distal end; 0.18 mm. long, or twice the length of the tarsi. Style black, hirsute, bluntly rounded at the tip; length, 0.10 mm., or a little more than half the length of the honey-tubes. Total length of the body, 1.28 mm.

This form was taken May 23, on the primrose (*Œnothera biennis*). It is gregarious in habit and colonizes the terminal growing parts of the plant. In Aphid. Minn., p. 62, 1887, Oestlund names this species *œnotheræ*, but it seems to be identical with *gossypii* Glov.

Aphis vernonia Thomas Plate XXII, fig. 100.

Head black. Antennæ light gray, imbricated, and almost naked; length of segments: I, 0.03 mm.; II, 0.05 mm.; III, 0.16 mm.; IV, 0.07 mm.; V, 0.09 mm.; VI, 0.09 mm.; VII, 0.16 mm.; total length, 0.70 mm., which extends a little beyond the thorax, or about two-thirds the length of the body. Sensoria circular, four to eight on the third joint, sometimes one near the central part of the fourth joint, the usual one present near the distal end of the fifth, and a cluster of about five which border a larger one at the distal end of the sixth joint. Eyes red; ocular tubercles prominent; ocelli normal and conspicuous. Beak dark, 0.50 mm. long, extending to the central part of the abdomen in some specimens, in others not quite as far, but most always extending as far as do the antennæ.

Prothorax light brown, except the cephalic margin, which is black; lateral tubercles well developed and prominent. Thoracic sclerites black, membrane lighter in color. Wings nearly hyaline, veins dark. Stigma brownish black, 0.09 mm. broad and 0.45 mm. long. Total wing expansion, 3.70 mm. Legs nearly uniform in color, being pale yellow; tibia and tarsi a shade lighter and slightly hirsute.

Abdomen pale brown, with two tubercles caudad the honey-tubes about the size of the lateral tubercles. Honey-tubes cylindrical and imbricated, 0.25 mm. long, or about twice the length of the tarsi. Style concolorous with the abdomen, hirsute, also armed with short spines. It is bluntly rounded at the distal end and 0.09 mm. long, or a little less than one-half the length of the honey-tubes. Total length of the body, 1.18 mm.

This form was taken July 9, on ironweed (*Vernonia baldwini*). It is gregarious, and colonizes the tender terminal growing parts. This form is similar to the genus *Sipha* in size, shape, and especially in the construction of the third and fourth antennal joints, inasmuch as they are not as distinctly divided as is common in the genus *Aphis*, but appear as a gradation between the two genera.

Aphis. Plate V, fig. 35.

Head black. Antennæ dark, imbricated, and almost naked; length of segments: I, 0.09 mm.; II, 0.05 mm.; III, 0.36 mm.; IV, 0.23 mm.; V, 0.18 mm.; VI, 0.09 mm.; VII, 0.34 mm.; total length, 1.30 mm., or extending to near the center of the abdomen. Sensoria circular, fifteen to twenty on the third joint, ten to twelve on the fourth, usually two or three on the fifth, and a cluster of four or five at the distal end of the sixth. Eyes black; ocular tubercles prominent, tinged with red; ocelli normal. Beak dark, 0.54 mm. long, extending midway between the pro- and mesocoxæ.

Prothorax black, lateral tubercles prominent. Thorax black; wings hyaline, veins brown. Stigma light brown, 0.18 mm. broad and 1.07 mm. long. Total wing expansion, 7.70 mm. Legs hirsute, dark except the tibia, which are a shade lighter.

Abdomen blackish. Honey-tubes black, clavate, being dilated at the distal ends; length, 0.18 mm., being two and one-half times the length of the tarsi. Style black, hirsute, bluntly rounded at the tip and turned dorsad; 0.09 mm. in length, or one-half the length of the honey-tubes. Total length of the body, 1.90 mm.

This form was taken April 25, on waahoo (*Euonymus atropurpureus*). It is gregarious in habit, and colonizes the leaves.

Aphis maidis Fitch. Plate XI, fig. 66.

Head black. Antennæ black, with few scattered hairs; length of segments: I, 0.07 mm.; II, 0.07 mm.; III, 0.34 mm.; IV, 0.19 mm.; V, 0.16 mm.; VI, 0.10 mm.; VII, 0.14

mm.; total length, 1.10 mm., distal end of the sixth joint extending to the abdomen. Sensoria circular, about eighteen or twenty on the third, four on the fourth, sometimes in a row, three or four on the fifth, six small with one large at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli present, frontal one conspicuous, others not very conspicuous. Beak dark, 0.35 mm. long, extending to the mesathorax.

Prothorax black, lateral tubercles small and conspicuous. Thorax black; wings subhyaline, veins rather frail. Stigma black, 0.16 mm. broad and 0.99 mm. long. Total wing expansion, 7.68 mm. Legs black, slightly hirsute.

Abdomen bluish green, with five black spots on each lateral margin, also three black but not very distinct transverse bars caudad the honey-tubes. One lateral tubercle on each margin of the basal tergum; one on each of the two first terga caudad the honey-tubes. These tubercles are all about equal to the prothoracic tubercles in size. Honey-tubes black, imbricated, slightly dilated in the middle and expanded at the rim. Each is located in a black patch. At the cephalic base of each tube is a small semicircular brownish patch. Length, 0.16 mm., not extending to the base of the style, and but little longer than the style. Latter black on the distal half, with the color extending cephalad along the margin to the base. Cephalic half in this margin concolorous with the abdomen. Armed with few hairs and numerous small spines. The distal end is turned dorsad. Length, 0.12 mm., being half the length of the tarsi. Total length of the body, 2.35 mm.

This form was taken September 4, on cultivated corn (*Zea mays*). It is gregarious, and attacks the corn in practically the same manner as the chinch-bug. It is most numerous on the distal joint of the stalk, being protected by the sheath of the last leaf.

Aphis cerasifoliæ Fitch. Plate X, fig. 59.

Description from an apterous, viviparous form.

Head black. Antennæ black except the third and sometimes the fourth joint, which is of a light color; all slightly hirsute; length of segments: I, 0.09 mm.; II, 0.07 mm.; III, 0.39 mm.; IV, 0.23 mm.; V, 0.23 mm.; VI, 0.09 mm.; VII, 0.54 mm.; total length, 1.45 mm., extending to the central part of the abdomen. Sensoria few and circular; the usual distal one on the fifth, and the cluster of six or seven at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli absent, or if present not conspicuous. Beak black, 0.28 mm. long, extending to the abdomen.

Prothorax black; has conspicuous lateral tubercles. Thorax black. Legs all black except the proximal two-thirds of the tibia, which is of a light color.

Abdomen black. Honey-tubes black, incrassate, thickest near the base and tapering toward the distal end, where they sometimes dilate into an imperfect knob; length, 0.27 mm., being about three times the length of the tarsum. Style light-colored, hirsute, and 0.18 mm. long, or two-thirds the length of the honey-tubes. Total length of the body, 1.99 mm.; width at the thorax, 0.90 mm.

This form was taken May 7, on the cultivated plum (*Prunus* sp. ?). It is gregarious and colonizes the leaves, sometimes corrugating them.

Aphis sambuci Linn. Plate X, fig. 60.

Head black. Antennæ black, slightly hirsute; length of segments: I, 0.07 mm.; II, 0.07 mm.; III, 0.25 mm.; IV, 0.23 mm.; V, 0.18 mm.; VI, 0.12 mm.; VII, 0.34 mm.; total length, 1.23 mm., extending to the honey-tubes. Sensoria circular, unequal in size, and twenty to twenty-five on the third joint, from one to five on the fourth, about three on the fifth, seven small and one large at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli normal. Beak black, discoidals bounded caudad with a narrow dark line. Stigma dark, 0.14 mm. broad and 0.54 mm. long. Total wing expansion, 6.72 mm. Tarsi, distal part of the tibia and femora black; remainder brown.

Abdomen slate-colored. Honey-tubes black, imbricated, cylindrical, and dilated at the distal end, forming a flat rim; length, 0.37 mm., or about four and one-half times the length of the tarsum. Style black, bluntly rounded at the end, hirsute, and armed with small spines. Length, 0.12 mm., or about one-third the length of the honey-tubes.

This form was taken June 15, on the elder (*Sambucus cana-*

densis). It is gregarious and colonizes the terminal twigs, often killing them with its secretions, which choke the stomata of the leaves. There seem to be two varieties of this aphis on the same host-plant.

A form has been described by Fitch which colonizes the ventral side of the leaves of the elder, but since I have found two forms on the same plant, it is difficult to tell which is meant from his meager description to be *sambucifoliæ*. However, I shall give this form Linn's determination, and the other form, shown on plate XIX, figure 91, Fitch's determination. Thomas supposed the two names to be synonymous, but he had neither of the species at hand from which to determine the proof of his statement.

Syphocryne avenæ Fabr. **Plate VIII, fig. 49.**

Head dark. Antennæ light brown, and hirsute; length of segments: I, 0.05 mm.; II, 0.07 mm.; III, 0.07 mm.; IV, 0.23 mm.; V, 0.21 mm.; VI, 0.09 mm.; VII, 0.29 mm.; total length, 1.21 mm. Sensoria of the third about eight, sometimes in a single row; none on the fourth; on the fifth the usual one near the distal end; six small ones around a large one near the unguis of the sixth. Eyes black; ocular tubercles tinged with red; ocelli present but not prominent. Beak concolorous and extending to the third coxa, being 0.72 mm. long.

Prothorax light brown, with a dark cephalic border. The lateral tubercles are quite conspicuous, although the prothorax is short. Thorax dark brown. Wings slightly brownish, veins light brown. Stigma of a lighter brown, 0.14 mm. wide and 0.61 mm. long. Total expansion of wings, 4.89 mm. Legs light brown, except the articulations, which are darker; all rather finely hirsute. Metathoracic legs are long in proportion to the others.

Abdomen brown, lateral margins somewhat tuberculate; four or five black spots on each lateral margin. Honey-tubes black, imbricated, and cylindrical; the distal ends have narrow, expanding rims; length, 0.27 mm. Style black and spinous, except the proximal part, which is concolorous with the abdomen, and the lateral boundaries, which are concolorous with the distal end.

This form was taken April 16, on the apple tree. It is gregarious, and colonizes the terminal buds and tender stems, also both sides of the leaves. This brood hatches from the eggs which have been deposited in the leaf-scales of the buds and the crevices of the bark the previous fall. The young lice are predominantly green.

Aphis sp.? Plate XI, fig. 62.

Head black. Antennæ black, with but few hairs; length of joints: I, 0.09 mm.; II, 0.07 mm.; III, 0.54 mm.; IV, 0.37 mm.; V, 0.28 mm.; VI, 0.14 mm.; VII, 0.63 mm.; total length, 2.12 mm., being about the length of the honey-tubes longer than the body. Sensoria circular, between forty and fifty on the third joint, between fifteen and twenty on the fourth, about ten on the fifth, the distal one being about three times greater in diameter than the others; six small and one large at the distal end of the sixth. Eyes black; ocular tubercles small and not very prominent; ocelli present but not very conspicuous. Beak dark, 0.45 mm. long, extending to the mesocoxæ.

Prothorax dark, cephalic border black; thorax black; wings subhyaline, veins black, very robust, and margined with a very faint smoky border not wider than the vein itself. Stigma black, 0.14 mm. broad and 0.72 mm. long. Total wing expansion, 6.40 mm. Legs all black except the proximal part, which is sometimes brownish.

Abdomen dark green, with four black spots on each lateral margin. Honey-tubes black, incrassate, distal two-thirds dilated, 0.34 mm. long, being a little longer than twice the tarsi in length, extending nearly to the distal end of the style. The latter is black with a few long, spreading hairs; also armed with numerous small spines. Length, 0.14 mm., equal to the tarsum in length. Total length of the body, 1.99 mm.

This form was taken October 12, on the cultivated raspberry (*Rubus occidentalis*). It seems to be somewhat sporadic in habit, since only a few were found at the time. Earlier in the season a colony was found on the terminal stems of the wild raspberry, but none were collected on account of their sudden disappearance, due to a hard wind- and rain-storm.

Aphis sp. Koch. Plate XIV, fig. 77.

Head dark. Antennæ a shade lighter in color, imbricated, and almost bare; length of segments: I, 0.07 mm.; II, 0.05

mm.; III, 0.45 mm.; IV, 0.28 mm.; V, 0.28 mm.; VI, 0.10 mm.; VII, 0.50 mm.; total length, 1.78 mm., being about the length of the tarsum longer than the body. Sensoria circular and unequal in size; there are fifteen or twenty on the third segment, five to eight in a row on the fourth, five or six on the fifth, and a cluster of about six unequal in size on the distal end of the sixth. Eyes black; ocular tubercles inconspicuous; ocelli inconspicuous. Beak dark, 0.45 mm. in length, extending to the abdomen.

Thorax of a mild black; wings lightly pellucid, veins dark and frail. The subcostal is bounded caudad with a faint light band. The stigma is dark and 0.09 mm. broad by 0.45 mm. long. Total wing expansion, 4.00 mm. Legs black, a shade lighter at the bases, slightly hirsute, and normal in length.

Abdomen pale yellow, with about seven black patches located as shown in the illustration, and four or five lateral black spots. These patches are variable in size and number. Honey-tubes are black, imbricated, and cylindrical, with a slight dilation at the base; 0.19 mm. in length, or about one and one-half times the length of the tarsi. Style black, except a small basal part; hirsute, spinous, ensiform, and 0.09 mm. long, being half the length of the honey-tubes. Total length of the body, 1.28 mm.

This form was taken November 1, on the cultivated strawberry (*Fragaria virginiana*). It is somewhat sporadic, but forms small colonies on the dorsal side of the leaves. The apterous forms have more pronounced frontal tubercles than the winged forms.

Aphis gossypii Glov. Plate XI, fig. 64.

Head black. Antennæ dark, latter imbricated, and almost bare; length of segments: I, 0.07 mm.; II, 0.05 mm.; III, 0.27 mm.; IV, 0.18 mm.; V, 0.16 mm.; VI, 0.09 mm.; VII, 0.27 mm.; total length, 1.37 mm., or about the length of the third joint shorter than the body. Sensoria circular and large; there are from eight to ten on the third joint, none on the fourth, the usual distal one on the fifth, and about six small ones of unequal size at the distal end of the sixth. Eyes are black; ocular tubercles prominent; ocelli normal. The beak is dark, 0.50 mm. long, and extends to the mesacoxæ.

Prothorax dark, lateral tubercles prominent and conspicuous.

Thorax dark. Wings nearly hyaline, being slightly pellucid, veins frail and dark; stigma dark gray, 0.10 mm. wide and 0.54 mm. long; total wing expansion, 4.68 mm. Legs black on the distal half of the femora; distal part of the tibia, and the tarsum dark brown, remainder pale brown. Legs are normal in proportion.

Abdomen pale brown, with four black spots on each lateral margin; two transverse dark bars caudad the honey-tubes; mesocaudad the honey-tubes and bordering their bases are two larger patches of the same color. The portion ventrad the style is also dark. The honey-tubes are black, imbricated, and almost cylindrical, being a little wider at the base than at the distal end; length, 0.18 mm., being nearly twice the length of the tarsum. Style black, hirsute, bristled, and bluntly rounded at the apex; 0.10 mm. long, being equal to the tarsum in length.

This form was taken January 3, on the greenhouse *Hibiscus*. It seems to be common in greenhouses during the winter. Being gregarious, it colonizes the dorsal surface of the leaves.

Rhopalosiphum violæ Pergande. Plate XV, fig. 78.

Head black. Antennæ black, hirsute, first joint glabrous; length of joints: I, 0.109 mm.; II, 0.07 mm.; III, 0.48 mm.; IV, 0.34 mm.; V, 0.36 mm.; VI, 0.14 mm.; VII, 0.56 mm.; total length, 2.00 mm. Sensoria circular, moderately small, and numerous, being about thirty-six on the third joint; on the fourth are eleven, nearly in a straight row; the usual one is near the distal end of the fifth; one large one and a cluster near it of six small ones near the distal end of the sixth. Eyes pinkish red; ocular tubercles well developed and of a lighter tinge than the eyes. Beak grayish and extending to the mesocoxæ, being 0.45 mm. long.

Prothorax grayish black with membrane of pinkish yellow. Dorsum of the thorax black with a membrane of pinkish yellow. Wings hyaline; discoidals all black with broad, fainter black borders; all very characteristic. Stigma grayish black, 0.47 mm. long by 0.129 mm. wide; total wing expansion, 4.89 mm. Femora of legs black, except the proximal parts, which are pinkish yellow. The tibia are dark yellow, with the distal parts the darkest. Tarsi are a shade lighter and hirsute.

Abdomen is pinkish yellow with about four black splotches on the lateral margins. There are two black transverse bars caudad of the honey-tubes and six cephalad. Three or four of the latter are sometimes continuous, forming a quadrate patch irregular in outline. The honey-tubes are dark gray, incrassate, and 0.27 mm. long. The style is concolorous with the abdomen, cone-shaped, and 0.09 mm. long.

This aphid is gregarious on greenhouse violets and colonizes mostly the ventral side of the leaves. Some will feign death when disturbed and fall from the leaves; others will remain with a firmer grasp than ever.

Rhopalosiphum rois Monell. Plate XIII, fig. 73.

Head brown. Antennæ dark and slightly hirsute; length of segments: I, 0.07 mm.; II, 0.07 mm.; III, 0.50 mm.; IV, 0.43 mm.; V, 0.34 mm.; VI, 0.16 mm.; VII, 0.54 mm.; total length, about 2.08 mm., or about the length of the honey-tube longer than the body. Sensoria circular; six to twelve on the third joint, in a row; none on the fourth; the usual one near the distal end of the fifth; about five small and one large one at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli conspicuous. Beak black, 0.45 mm. long, and extending midway between the pro- and mesocoxæ.

Thorax all dark brown. Wings hyaline, veins black; first discoidal bordered with a narrow margin of a dark brown about as wide as the vein itself; second discoidal bordered in the same manner but fainter. The subcostal is also bordered with the same on its caudal margin. The stigma is dark brown, 0.12 mm. wide and 0.72 mm. long. Total wing expansion, 7.12 mm. Legs all dark, hirsute, and long in proportion to the body.

Abdomen light brown. Honey-tubes dark, dilated more distally than proximally; they are 0.39 mm. long, or twice the length of the tarsi. Style dark, hirsute, and conical, 0.18 mm. long, or one-half the length of the honey-tubes. Total length of the body, 1.81 mm.

This form was taken June 27, on sumac (*Rhus glabra*). It is gregarious and colonizes the tender stems, petioles, and the ventral side of the leaves. The individuals remain quite near each other while on this host-plant, and have a remarkably good protective coloration.

Rhopalosiphum dianthi Schrank. Plate IX, fig. 55.

Head black. Antennæ black, with a few hairs; length of segments: I, 0.09 mm.; II, 0.07 mm.; III, 0.45 mm.; IV, 0.37 mm.; V, 0.30 mm.; VI, 0.12 mm.; VII, 0.41 mm.; total length of antennæ, about 1.81 mm., or about the length of the fifth segment longer than the body. Sensoria circular; ten to twelve on the third joint, none on the fourth, the usual distal one on the fifth, and about seven of unequal size at the distal end of the sixth. Eyes red; ocular tubercles prominent and red; ocelli prominent. Beak black, 0.36 mm. long, extending to the mesocoxæ.

Prothorax black; thorax black. Wings hyaline, veins frail and dark brown in color. Stigma and costal veins light brown. Stigma, 0.10 mm. broad and 0.77 mm. long. Total wing expansion, 6.52 mm. Distal half of femora black; distal end of the tibia and the tarsi black; all slightly hirsute. Legs all long in proportion to the body.

Abdomen pale green, with black markings on the dorsal surface. In old specimens these black splotches frequently become confluent, forming an irregular dark area, as shown in the illustration. Honey-tubes black in old specimens, but slightly pale at the base in younger ones. They are incrassate, being enlarged on the distal half more than is shown in the illustration. Length, 0.36 mm., or about one and a half times the length of the tarsum. Style black, hirsute, and spinous, somewhat curved in the center, so that the distal end is turned dorsad. Length, 0.18 mm., or half the length of the honey-tubes. Total length of the body, 1.80 mm.

This form was taken April 25, on the pansy (*Viola tricolor?*) It seems to be a greenhouse form, since the plants affected were transplanted from hotbeds to open air, which served as hosts for the innumerable form which colonized all parts of them, beginning on the ventral side of the leaves.

Genus **Macrosiphum** Passerini [21]

Front grooved. Antennæ filiform, nearly always longer than the body, and on distinct and approximate frontal tubercles.

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[21] This genus has had a profuse confusion of names. Following are some of Theo. Pergande's conclusions on the subject, which seem to be final: "In accordance with priority, the generic term *Siphonophora*, as adopted by Koch, had already been preoccupied by Eschscholtz and described by him in '‚Syst. d. Acaleph,' in 1829, though, without knowing this fact, it was again applied by Brandt (Bull. Acad. St. Petersburg) in 1836, for a genus belonging to the Myriopoda. Oestlund, recognizing the preoccupation of *Siphonophora*, substituted for it (Aphididæ of Minnesota, p. 78, 1887) the name *Nectarophora*, overlooking the fact that *Nectarophora* wa

The two basic joints short and thick; third, fourth and fifth joints long; the third joint long, but not always as long as the setaceous seventh. Beak moderately long. Distal joint about equal to the penultimate. Prothorax in rare instances with a lateral tubercle. Wings large and normally veined. Honey-tubes long, often extending beyond the style, cylindrical, tapering, and nearly always straight. Style long, generally recurved, and ensiform.

Genus **Myzus** Passerini.

Antennæ about equal in length to the body, on moderately distinct frontal tubercles, which are gibbous on the inner side. First joint of the antennæ also gibbous, but not dentate. Wings moderately long, venation normal. Body often with capitate hairs. Legs moderately long and robust. Honey-tubes rather long and cylindrical.

Genus **Nectarosiphum** Oestlund.[22]

Antennæ as long or longer than the body, on moderately large frontal tubercles, but not approximate as in the *Nectarophora*. Prothorax well developed, with a distinct lateral tubercle. Wings rather long and clouded near the apex. Legs long and slender. Honey-tubes very long, much dilated in the middle, and curved. Style long and conspicuous.

Genus **Phorodon** Passerini.

Vertex flat. Antennæ scarcely longer than the body, situated on frontal tubercles, each with a characteristic tooth developed on the inner side. First joint bluntly toothed, or gibbous, which is of much importance, since the frontal tubercles are not significant without this; third joint the longest; fourth and fifth joints nearly equal in length. Beak moderately long, extending to the second coxa. Wings moderately long, with a normal venation.

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antedated by *Macrosiphum* Pass. (Gli Afidi, p. 27, 1860), a generic term unfortunately adopted by Oestlund for a species with long, clavate nectaries, found on *Rubus strigosus*, which he named *Macrosiphum rubicola*, a generic term also adopted by Del Guerico (Afidafauna Italica, pp. 144 and 159) for a number of species agreeing with the characters of *Macrosiphum* Oestlund, overlooking, however, the fact that *Macrosiphum* was preoccupied by Passerini for a genus structurally quite different. Dr. M. H. Schoutenden was the first to observe this error, and changed *Macrosiphum* Oestlund to *Nectarosiphon*, in contradistinction to *Macrosiphum* Passerini."—U. S. Dept. of Agric., Div. Ent., Bull. No. 44, pp. 13 and 14, 1904.

[22] No representative in this text.

Myzus cerasi Fab. Plate IX, fig. 54.

Head and antennæ black, latter imbricated. Length of segments: I, 0.10 mm.; II, 0.07 mm.; III, 0.45 mm.; IV, 0.32 mm.; V, 0.25 mm.; VI, 0.10 mm.; VII, 0.41 mm.; total length of antennæ, 1.70 mm., or extending a little farther than to the abdomen. Sensoria circular, about twelve to the third joint, nearly in a row; absent on the fourth, but the usual one present near the distal end of the fifth; a cluster of about six on the distal end of the sixth and the base of the seventh. These vary in size and are each mounted with small, numerous hairs. Eyes black; ocular tubercles prominent, tinged with red; ocelli normal. Beak black, 0.45 mm. long, extending to the mesocoxæ.

Prothorax black; a small elevation marks the location of the absent tubercles. Thorax black. Wings hyaline, venation brownish and slender; stigma, 0.63 mm. long by 0.10 mm. broad. Total wing expansion, 5.90 mm. Legs black, hirsute; color lightest on the tibia to near the distal end.

Abdomen black, short, and broad, which gives it an ovoid appearance. Honey-tubes black, imbricated, and incrassate, being twice as wide at the base as near the distal end; latter funnel-shaped; entire length, 0.41 mm., or about four times the length of the tarsum. Style black, covered with short spines and a few hairs. It is conical in shape, and 0.14 mm. long, being about four times the length of the honey-tubes. Total length of the body, 2.08 mm.

This form was taken June 16, on the cultivated cherry. It is gregarious, colonizing the leaves, and when quite numerous also the tender twigs. They are quite conspicuous, being black on a green plant. In general appearance the wingless, however, are more of a brownish cast. Whole colonies of these have been totally exterminated here in only a few days, supposedly from the action of some parasitic enemy.

Myzus persicæ Sulz. Plate XVI, fig. 81.

Head black. Antennæ black and with but few hairs; length of joints: I, 0.14 mm.; II, 0.09 mm.; III, 0.68 mm.; IV, 0.61 mm.; V, 0.43 mm.; VI, 0.18 mm.; VII, 0.72 mm.; total length, 2.85 mm., extending beyond the abdomen about the length of the honey-tubes. Sensoria circular; twelve to fourteen on the third, none on the fourth; the usual distal one on the fifth, which is nicely bordered with over-encircling hairs; one similar to that on the fifth, with a bunch of five or six small ones at the distal end of the sixth. Eyes dark red; ocular tubercles prominent; frontal ocellus prominent, dorsal ocelli present but not conspicuous. Beak dark, 0.36 mm. long, extending to the metathorax.

Thorax all black. Wings subhyaline; stigma dark, 0.19 mm. broad and 0.90 mm. long. Total wing expansion 6.52 mm. Legs slightly hirsute, the tibia long in proportion to the body.

Abdomen dark green, with black dorsal markings. Sometimes the transverse bars nearest the honey-tubes are confluent, forming a large irregular patch. In addition to these bars on the terga are black spots on the lateral margins of the same. The honey-tubes are black, incrassate, being enlarged on the distal half; also they have narrow expanded rims; length, 0.48 mm., being a little more than two and one-half times the tarsi in length. Style black, with a few long, spreading hairs and numerous small spines; the tip is turned dorsad; length, 0.21 mm., or a little less than half the length of the honey-tubes. Total length of the body, 1.99 mm.

This form was taken October 12, on the cultivated peach. It colonizes the ventral side of the leaf, but has not been very numerous here.

Myzus prunifoliæ Fitch. Plate IV, fig. 31.

Head dark brown. Antennæ nearly bare, imbricated; first two joints concolorous with the head; basal third of the third nearly white, distal two-thirds dark brown; basal half of the fourth lighter than the dark brown distal half; fifth dark brown except a small basal portion; sixth and basal part of the seventh dark brown, remainder lighter in color. Length of segments: I, 0.09 mm.; II, 0.07 mm.; III, 0.27 mm.; IV, 0.21 mm.; V, 0.19 mm.; VI, 0.09 mm.; VII, 0.88 mm.; total length, 1.80 mm., extending a little caudad the body. Sensoria circular; six or eight on the third joint, none on the fourth, the usual one present on the distal end of the fifth, six small, equal in size and one larger one at the distal end of the sixth. Eyes black; ocular tubercles present but not prominent; ocelli not conspicuous. Beak light-colored, except the distal end, which is dark; length, 0.45 mm., extending to the mesocoxæ.

Prothorax dark brown, short, and arched. Thorax dark brown and arched slightly. Wings pellucid, veins dark brown. Stigma dark brown, 0.12 mm. broad and 0.54 mm. long; total wing expansion, 5.40 mm. Legs hirsute; tarsi, distal part of the tibia and the distal part of the femora black, remainder light colored. Hind tibia a little long in proportion.

Abdomen dark brown. On each lateral margin are at least three tubercles. Honey-tubes concolorous, cylindrical, and imbricated like the antennæ; length, 0.28 mm., or about one and one-half times the length of the tarsi. Style lighter in color than the body, armed with numerous small spines and about four long, setaceous hairs; length, 0.18 mm., or equal to the tarsi in length. Total length of the body, 1.54 mm.

This form was taken on the cultivated plum, July 9. It is gregarious and colonizes the surface of the leaves, which causes them to curl and form pseudogalls in which the aphids are more or less protected from parasites. Ants were noticed to patronize these colonies and to kill aphis-lions and ladybird beetles which were trying to devour the aphids.

Myzus achyrantes Monell. Plate IX, fig. 53

Head and antennæ nearly black; latter imbricated and almost naked. Length of segments: I, 0.12 mm.; II, 0.07 mm.; III, 0.55 mm.; IV, 0.41 mm.; V, 0.30 mm.; VI, 0.12 mm.; VII, 0.54 mm.; total length, 2.00 mm., or equal to the body in length. Sensoria circular, unequal in size; ten to the third joint, none on the fourth, the usual distal one on the fifth, about five and one large at the distal end of the sixth. Eyes dark red; ocular tubercles prominent; cephalic ocellus prominent, others not very conspicuous. Beak dark, and extends midway between the pro- and mesocoxæ, being 0.45 mm. long.

Thoracic sclerites all black. Wings hyaline, veins black. Stigma, 0.12 mm. broad and 0.81 mm. long. Total wing expansion, 3.60 mm. Distal half of the femur, distal part of tibia and tarsi black, remainder pale brown.

Abdomen has a background of yellowish brown, bordered on the lateral margins with a black spot to each segment, and on the dorsum with two, three or four spots on each of the first three segments, a transverse black bar between the style and the honey-tubes; also a confluent patch is cephalad the latter. Honey-tubes are incrassate and black, 0.41 mm. long, or three times the length of the tarsum. The style is black, 0.19 mm. long, hirsute, and gradually tapers to a point. It is about equal to the tarsus in length. Total length of the body, 2.04 mm.

This form was taken on the sweet alyssum (*Alyssum maratimum*), *Asparagus plumosa*, willow (*Salix* sp.), and gladiolus. It is gregarious in habit and colonizes the leaves.

Macrosiphum, n. sp. Plate XV, fig. 79.

Head black. Antennæ hirsute, bristly in nature, and of a capitate character. All segments of a mottled black except the base of the third, which is light in color. Length of segments: I, 0.14 mm.; II, 0.07 mm.; III, 0.63 mm.; IV, 0.59 mm.; V, 0.57 mm.; VI, 0.13 mm.; VII, 0.99 mm.; total length of antennæ, 3.00 mm., or twice the length of the body. Sensoria circular, few, and small, being about eight in a row on the third segment, none on the fourth, the usual one near the distal end of the fifth, and a large one with five small ones at the distal end of the sixth. Eyes red; ocular tubercles prominent; ocelli present but not prominent. Beak dark, hirsute distal segment black. Total length, 0.54 mm., extending to the abdomen.

Prothorax brown; thorax black. Wings of a brownish tinge. First discoidal with a very heavy border of dark brown; second discoidal marked with a little less of the same; third discoidal and stigma not bordered, but brown in color. Stigma, 0.63 mm. long by 0.0 mm. broad. The caudal boundary of the stigma is darker than the cephalic boundary. Total wing expansion, 4.94 mm. Legs hirsute, the hairs are short, stiff, and bristly in nature. Tarsi, distal ends of femora and each end of tibia black. Legs all slender in proportion to the body.

Abdomen dark, with scattering, short, somewhat capitate hairs. Honey-tubes imbricated, black, cylindrical, and 0.41 mm. long, being about four times the length of the tarsi. At the base cephalad the honey-tubes is a light-colored crescent. This as well as each honey-tube is situated on a tubercular prominence of the abdomen. Style ensiform, lighter in color than the abdomen, dirty gray. At the distal end is one long, capitate hair; other hairs are present, distributed toward the base. It is 0.14 mm. long, being about one-third the length of the honey-tubes. Total length of the body, 3.60 mm. Mr. Pergande identifies this as a new species of *Macrosiphum*.

This form was taken July 22, on a plant which was destroyed before it could be identified. The species is gregarious, and colonizes the tender, growing parts of the plant. From the specimens the anomalous features of the wing venation may be seen. On about ninety per cent. of the individuals studied the venation appeared as shown on the slide, where in the remainder a frequent slight third branching of the third discoidal was noticed. In one specimen it was nearly perfect on one wing. Also the appearance of a single discoidal on the caudal wing was noticed in a few specimens, but in none was it perfect. The relative size of the caudal wing is very noticeable. With the exceptions of the abnormalities of the wings, this form appears to be a very good representative of the genus *Macrosiphum*. The apterous forms could without doubt be classified as distinctly of this genus.

Macrosiphum sp. ? Plate XIX, fig. 90.

Head and basal joints of the antennæ dark brown. Antennæ black and hirsute; length of segments: I, 0.14 mm.; II, 0.09 mm.; III, 0.82 mm.; IV, 0.80 mm.; V, 0.70 mm.; VI, 0.18 mm.; VII, 1.00 mm.; total length, 3.73 mm., or about twice the length of the body. Sensoria circular, irregular in size and numerous; on the third joint fifty or more, on the fourth twelve, and nearly in a straight row; ten to fifteen on the fifth; a cluster of seven of equal size and a larger one at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli normal. Beak dark, 0.80 mm. long, and extends to the mesocoxæ.

Prothorax dark brown, cephalic margin black. Thorax of a darker brown. Wings hyaline, discoidals dark brown, costals light brown. Stigma dark brown, 0.19 mm. broad and 0.90 mm. long. Total wing expansion, 6.52 mm. Legs black, except proximally from the center of the femora, which is yellowish brown.

Abdomen dark brown. Honey-tubes black, imbricated, and 0.45 mm. long, being twice the length of the tarsi. Style hirsute, concolorous with the abdomen, widest near the middle and

0.23 mm. long, being one-half the length of the honey-tubes. Total length of the body, 1.98 mm.

This seems to be a male form, and was taken June 21, on the wing. Data not sufficient for identification.

Macrosiphum, n. sp. Plate XX, fig. 93.

Head dark green. Antennæ black, slightly hirsute; length of segments: I, 0.18 mm.; II, 0.09 mm.; III, 0.86 mm.; IV, 0.12 mm.; V, 0.82 mm.; VI, 0.18 mm.; VII, 1.09 mm.; total length, 3.34 mm., the fifth joint extending to the tip of the abdomen. Sensoria circular, unequal in size; about twenty-five on the third, none on the fourth, the usual distal one on the fifth, six small and one large, the latter equal to the distal fifth, on the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli present, bordered with black. Beak dark, 0.63 mm. long, extending nearly to the mesocoxæ.

Thorax all dark green. Wings hyaline; the first two discoidals strong, the first bordered with a conspicuous border of black as wide as the vein itself; second also bordered with the same but fainter. The cubitus and stigmal vein not bordered but somewhat frail. Stigma dark gray, black along the caudal margin; length, 1.28 mm.; breadth, 0.18 mm. Total wing expansion, 7.68 mm. Legs long, slightly hirsute; tarsi, tibia and distal half of the femora black, remainder greenish brown.

Abdomen reddish brown. Honey-tubes black, cylindrical, slightly dilated at the distal extremity, 0.73 mm. long, or four and one-half times the length of the tarsi, extending to the distal end of the style; the latter dark green, with a few long hairs and numerous short spines. The distal hair is capitate; length, 0.32 mm., or twice the length of the tarsum. Total length of the body, 2.70 mm.

This form was taken October 25, on the box-elder (*Negundo aceroides*). It is gregarious in habit and colonizes the ventral side of the leaves.

Macrosiphum chrysanthemi Oestlund. Plate XVII, fig. 85.

Head brownish black. Antennæ all dark except base of the third joint which is of a clearer brown. All the joints are hirsute. The I is 0.12 mm. long; II, 0.072 mm.; III, 0.59 mm.; IV, 0.34 mm.; V, 0.32 mm.; VI, 0.109 mm.; VII, 0.54

mm.; total length of antennæ, about 1.88 mm., extending beyond the abdomen. Sensoria of third joint are rather large, circular, irregular, and numerous, varying in number from twenty to thirty; sensoria of fourth about five in a row; of fifth, one near the distal end; of sixth, six small and one large sensorium at union of the seventh segment. Ocelli normal. Beak smoky from near the distal end to near the middle; distal segment narrow and nearly uniform in width; total length, 0.54 mm., reaching to the second coxa.

Prothorax brownish black; cephalic boundary black. Lateral tubercles very small. Thorax dark. Wings hyaline, veins slender, not distinctly colored but of a blackish cast. Third discoidal arising from the proximal part of the stigma, and obsolete at the base. Stigma a little more dense than the rest of the wing and darker in color, 0.63 mm. long and 0.09 mm. wide. Total wing expansion, 5.07 mm. Legs hirsute; distal end of the tibia and the tarsus dark; the proximal end of the tibia and the femur black. All of the appendages seem to be rather long in proportion to the remainder of the insect.

The abdomen is a shade lighter brown than the rest of the body, hirsute, more dense near the caudal part. Honey-tubes black, imbricated, and slightly incrassate, 0.23 mm. long. Style black, hirsute, and somewhat ensiform, 0.27 mm. long. Total length of body, 1.50 to 1.60 mm.

This form was taken May 30, 1903, on the common white chrysanthemum. It is gregarious, and colonizes the terminal buds and the tenderest stems, also the ventral side of the leaves.

Macrosiphum ambrosiæ Thomas. Plate XVIII, fig. 87.

Head light brown. Antennæ dark, hirsute; length of the first joint, 0.09 mm.; II, 0.09 mm.; III, 0.86 mm.; IV, 0.66 mm.; V, 0.60 mm.; VI, 0.14 mm.; VII, 1.28 mm.; total length, 3.08 mm. The sensoria of the third joint are numerous, varying from fifty to sixty; on the fourth joint are about twelve; at the distal end of the fifth is the usual large one; at the distal end of the sixth is one large sensorium surrounded by about three small ones. Eyes black with a tinge of brown. Ocelli normal, three in number. Beak brown, last segment dark, hirsute, 0.86 mm. long, extending to the mesocoxæ.

Prothorax light brown, except the cephalic margin. which is black. The thorax is dark brown. The wings are hyaline with light brown veins, which in this species are often quite anomalous, *i. e.*, having secondary branches. Stigma light brown, 0.97 mm. long and 0.16 mm. wide. Total wing expansion, 8.96 mm. Legs dark except the basal half of the femur, which is a very light brown. They are also hirsute and long in proportion to the body.

Abdomen brown; honey-tubes black, imbricated, and almost cylindrical, 0.50 mm. long. Style concolorous with the abdomen, ensiform, hirsute, and 0 50 mm. long. Total length of body, 2.70 mm.

This form was taken October 6. It is gregarious, and may be found on the tender parts and ventral sides of the leaves and tender branches of White snakeroot (*Eupatorium ageratoides*) as long as they contain sap. Described from a female specimen. For an illustration of an apterous, viviparous stem-mother, see plate XXII, fig. 99.

Macrosiphum, n. sp. Plate XXI, fig. 97.

Head black. Antennæ black except the base of the third joint, which is slightly pale; length of the antennal segments: I, 0.12 mm.: II, 0.05 mm.; III, 0.77 mm.; IV, 0.55 mm.; V, 0.54 mm.; VI, 0.14 mm.; VII, 0.59 mm.; total length, 3.15 mm. Sensoria of the third joint not distinct but numerous and of moderate size, there being thirty to forty; none on the fourth; a large one near the distal end of the fifth; the usual group present at the distal end of the sixth. Eyes are dark, tinged with red. Ocular tubercles are prominent and bordered with black. Beak dark, reaching to second coxa, and about 0.80 mm. in length.

Prothorax dark, rather narrow, and long. Thorax dark, almost black. Wings hyaline, veins slender and brownish. Stigma yellowish brown, 0.19 mm. broad by 0.90 mm. long. Total wing expansion, 7.92 mm. Legs hirsute and black except the proximal half of the femora.

Abdomen greenish black; honey-tubes black, cylindrical, imbricated, slightly trumpet-shaped at the tip, broader than this at the base, and 0.72 mm. long, extending to the tip of the abdomen. Style pale brown, imbricated, hirsute, broadest in the center and curved up at the tip, and 0.41 mm. long. Total length of body, 3.36 mm.

This form may be found in greenhouses during the growth of the *Bidens chrysanthemoides*. It is gregarious on this plant, colonizing the tender buds, stems, and leaves. It is also found common in gardens where chrysanthemums are, especially the white varieties.

Macrosiphum erigeronensis Thomas. Plate XIX, fig 92.

Head black. Antennæ slightly hirsute, dusky except the first two joints and base of the third joint; length of segments: I, 0.01 mm.; II, 0.07 mm.; III, 0.54 mm.; IV, 0.46 mm.; V, 0.36 mm.; VI, 0.14 mm.; VII, 0.64 mm.; total length 2.40 mm., being about equal to the body in length. Sensoria circular, prominent, and numerous; about forty on the third joint, none on the fourth, the usual distal one on the fifth, about six small and one large one at the distal end of the sixth.

Thorax all of a deep, shiny green. Lateral tubercles present in the apterous form but not conspicuous in the winged form. Wings hyaline, veins dark; discoidals frail. Stigma, 0.12 mm. broad and 0.54 mm. long. Total wing expansion, 5.80 mm. Proximal part of the femora yellowish brown, remainder of legs black, slightly hirsute, and nearly normal in size.

Abdomen of a shade lighter green than the thorax. Honey-tubes dark, imbricated, and almost cylindrical, being widest at the base; length, 0.45 mm., or about three times the length of the tarsi. Style dark green, slightly hirsute, armed with short spines, ensiform, and 0.27 mm. long, or half the length of the honey-tubes.

This form was taken October 19, on fleabane (*Erigeron canadensis*). It is gregarious in habit and colonizes the tender, growing parts.

Macrosiphum sp. Plate XVII, fig. 86.

Head and antennæ brownish black. Antennæ with a few spreading hairs; length of segments: I, 0.12 mm.; II, 0.09 mm.; III, 0.77 mm; IV, 0.70 mm.; V, 0.63 mm.; VI, 0.18 mm.; VII, 1.19 mm.; total length, 3.58 mm., or nearly twice as long as the body. Sensoria circular and unequal in size; forty to fifty on the third joint, none on the fourth, sixteen to twenty on the fifth, the distal one the largest, and nearly all in a row;

five or six small, with one large one, at the distal end of the sixth. Eyes dark red; ocular tubercles conspicuous; ocelli present but not conspicuous. Beak dark at the distal end, lighter proximally; length, 0.54 mm., extending a little beyond the metathorax.

Thorax dark, with yellowish membranes. Wings hyaline, venation dark, frail, and normal. Stigma dark, 0.19 mm. broad; 0.99 mm. long. Total wing expansion, 8.33 mm. Tarsi, distal ends of the tibia and femora dark, remainder brownish yellow. All hirsute.

Abdomen bluish green, with about five transverse bars of black. Honey-tubes cylindrical, slightly dilated at the distal ends, concolorous with the abdomen, except the distal ends, which are dark; length, 0.54 mm., three times the length of the tarsum, and extending a little distad the style. Latter black, armed with long, spreading hairs and numerous small spines, 0.23 mm. long, or a little less than half the length of the honey-tubes. Total length of the body, 1.99 mm.

This form was taken October 25, on sycamore (*Platanus occidentalis*). It seems to be sporadic in habit, as only a few were taken, on the ventral side of the leaves. It may not be a typical representative of any species.

Macrosiphum squarrosa, n. sp. Plate XVI, fig. 84.

Head brownish black. Antennæ black, except the first, second and base of the third joints, which are brownish; length of segments: I, 0.18 mm.; II, 0.09 mm.; III, 0.75 mm.; IV, 0.79 mm.; V, 0.72 mm.; VI, 0.18 mm.; VII, 1.37 mm.; total length, 4.12 mm. The first five joints are about equal to the length of the body. Sensoria numerous, circular, and unequal in size. They are not easily detected until cleared. The approximate number is not shown in the illustration, but there are generally about thirty to fifty on the third joint, and on the fourth, twelve to fifteen; on the fifth, fifteen to twenty; and on the distal end of the sixth about six small and one large one. Eyes black; ocular tubercles prominent; ocelli present. Beak black, 0.90 mm. long, and extends a little caudad the thorax.

Thorax all black. Wings hyaline, veins black, bordered with a very faint smoky tinge. Stigma brownish black, bordered caudad with a dark band which extends to the base of the subcostal vein. In width the stigma is 0.14 mm., and in length 1.00 mm. Total wing expansion, 8.64 mm. Legs hirsute, black, except proximal half of the femora. All long in proportion to the body.

Abdomen brownish black. Honey-tubes black, imbricated, and 0.50 to 0.70 mm. long., being about four times the length of the tarsi. Style black, hirsute, spinous, ensiform, and 0.30 mm. long, being half the length of the honey-tubes. Total length of the body, 2.37 mm.

This form was taken October 25, on *Actinomeris squarrosa*. It is gregarious in habit and colonizes the terminal stems.

Myzus biennis, n. sp. Plate IX, fig. 51.

Head light green. Antennæ concolorous except the third, sixth, seventh and distal end of the fifth joint, which are dark. Length of segments: I, 0.12 mm.; II, 0.07 mm.; III, 0.63 mm.; IV, 0.46 mm.; V, 0.48 mm.; VI, 0.12 mm.; VII, 0.81 mm.; total length, 3.60 mm. Sensoria circular, unequal in size; about twenty on the third joint, none on the fourth, six small and one large at the distal end of the sixth. Eyes red; ocular tubercles prominent; ocelli present but not conspicuous. Beak dark at the distal end, 0.72 mm. long, extending to the metacoxæ.

Prothorax green. Thorax green. Wings subhyaline, veins dark, somewhat frail. Stigma, 0.16 mm. broad and 0.66 mm. long; total wing expansion, 6.52 mm. Legs hirsute, and concolorous except tarsi and the distal end of the tibia, which are black, normal for this genus.

Abdomen green. Honey-tube imbricated, cylindrical; concolorous except the distal end, which is dusky; length, 0.48 mm., being at least two and one-half times the length of the tarsi, extending to the apical segment of the abdomen. Style concolorous, armed with numerous small spines and some long, setaceous hairs, ensiform, 0.34 mm. long, being about twice the length of the tarsum. Total length of the body, 2.58 mm.

This form was taken May 20, on primrose (*Œnothera biennis*). It is gregarious and colonizes the terminal stems.

Macrosiphum sp.? Plate XII, fig. 70.

Head dark brown. Antennæ black, except the second joint and the base of the third; length of joints: I, 0.12 mm.; II, 0.07 mm.; III, 0.72 mm.; IV, 0.61 mm.; V, 0.54 mm.; VI, 0.14 mm.; VII, 1.00 mm.; total length, about 2.27 mm., or about one and one-half times the length of the body. Sensoria circular, about fourteen on the third joint, none on the fourth, the usual distal one on the fifth, and about six of unequal size at the distal end of the sixth. Eyes very dark red; ocular tubercles prominent; ocelli prominent and bordered with black. Beak black at the distal end and paler proximally. It extends a little beyond the mesocoxæ, being 0.54 mm. long.

Prothorax and thorax pale brown. Wings hyaline; discoidals black, costals and stigma light brown. Breadth of stigma, 0.16 mm.; length, 0.79 mm. Total wing expansion, 6.52 mm. Legs hirsute, black, blackest at the articulations; long in proportion to the body.

Abdomen brownish green. Honey-tubes black, cylindrical, imbricated, and 0.68 mm. long, being about four times the length of the tarsum. Style black, hirsute, slender, and rounded at the tip; length, 0.32 mm., being about one-half the length of the honey-tubes. Total length of the body, 1.80 mm.

This form was taken May 5, on the cultivated tomato. It is sporadic in habit and feeds on the ventral side of the leaves.

Macrosiphum pisi Kalt. Plate XV, fig. 80.

Head dark brown. Antennæ black and hirsute; length of segments: I, 0.18 mm.; II, 0.11 mm.; III, 0.99 mm.; IV, 0.81 mm.; V. 0.73 mm.; VI, 0.16 mm.; VII, 1.09 mm.; total length, 4.15 mm., extending about 1 mm. beyond the abdomen. Sensoria circular, and of various sizes; about twenty-five on the third joint, none on the fourth, the usual one present near the distal end of the fifth. At the distal end of the sixth is a cluster of about six or eight small circular sensoria, which are closely connected with a large one situated in the same place. Eyes black; ocular tubercles red. Beak brownish, becoming black at the distal end, about 0.54 mm. long, extending about half-way to the mesocoxæ.

Prothorax dark brown; thorax dark brown. Wings hyaline, venation black; stigma pale brown, 0.81 mm. long by 0.14 broad. Total wing expansion, 6.35 mm. Legs hirsute, black except the proximal part of the femora, which is light brown.

Abdomen light brown. Honey-tubes black, imbricated, cylindrical, and 0.72 mm. long, or about ten times the length of the tarsi. Style hirsute, concolorous with the abdomen, 0.45 mm. long, or a little more than half the length of the honey-tubes. Total length of the body, 2.75 mm.

This form was taken from the cultivated rose, May 21. It is gregarious, and colonizes the terminal buds, leaves, and stems. This form may perhaps be called a variety of this species, since it does not correspond in every particular with the species named, yet the specimens taken, which were evidently of the same parentage, differed variously in color and size.

Macrosiphum. Plate XVIII, fig. 89.

Head dark green. Antennæ dark, except the first and second joints and the base of the third joint; length of segments: I, 0.14 mm.; II, 0.07 mm.; III, 0.84 mm.; IV, 0.72 mm., V, 0.66 mm.; VI, 0.18 mm.; VII, 0.66 mm.; total length, 3.80 mm., being the length of the seventh joint longer than the abdomen. Sensoria circular and unequal in size, fourteen to twenty on the third joint, none on the fourth, the usual distal one on the fifth, six small and one large one at the distal end of the sixth. Eyes dark red; ocelli bordered with black; ocular tubercles prominent. Beak light in color except the two distal segments, which are dark; length, 0.63 mm., extending to the mesocoxæ.

Thorax all dark green. Wings hyaline, veins dark. Stigma dark gray, 0.18 mm. broad and 0.90 mm. long. Total wing expansion, 5.60 mm. Tarsi and distal ends of the tibia and femora dark, remainder brownish yellow. All slightly hirsute.

Abdomen green. Honey-tubes dark, imbricated, cylindrical, and 0.79 mm. long, being four times the length of the tarsum. The style is hirsute and armed with short spines. It is long and slender, tapering gradually to a slender point; length, 0.36 mm., being about one-half the length of the honey-tubes. Total length of the body, 2.70 mm.

This form was taken May 17, on wild lettuce (*Lactuca scariola*). It is gregarious and colonizes the terminal stems.

Macrosiphum sp.? Plate XXI, fig. 98.

Head dark green. Antennæ black, except the first and second joints and the third, which are brownish; all slightly hirsute; length of segments: I, 0.14 mm.; II, 0.07 mm.; III, 0.73 mm.;

IV, 0.66 mm.; V, 0.61 mm.; VI, 0.16 mm.; VII, 0.97 mm.; total length, 3.08 mm.; omitting the last two segments, equal to the length of the body. Sensoria circular, unequal in size; twelve to twenty on the third joint, none on the fourth, the usual distal one on the fifth, five or six small ones bordering a larger one at the distal end of the sixth. Eyes black; ocular tubercles prominent; ocelli conspicuous, with black borders. Beak black on the distal half, remainder pale, 0.63 mm. long, extending to the mesocoxæ.

Thorax all dark green. Wings hyaline; discoidals black, costals dark brown; stigma dark, and 0.18 mm. broad by 0.81 mm. long. Total wing expansion, 7.85 mm. Legs long; the tarsi, distal part of the tibia and the femora black, remainder greenish yellow. All parts hirsute.

Abdomen greenish gray. Honey-tubes dark, imbricated, cylindrical, and 0.54 mm. long, being three times the length of the tarsum, extending nearly to the tip of the style. Style concolorous with the abdomen, slightly hirsute, long, and narrow, being two-thirds the length of the honey-tubes, or 0.36 mm. It is armed with short spines and has one characteristic long, setaceous hair located on the dorso-median line near the distal end. The style is 0.36 mm. long, or two-thirds the length of the honey-tubes. Total length of the body, 4.11 mm.

This form was taken October 23, on the ventral side of the leaf of a *Cucurbitacea* vine.

Phorodon sp. Plate XX, fig. 96.

Head black. Antennæ black and hirsute; first joint gibbous, 0.10 mm. long; II, 0.07 mm.; III, 0.50 mm.; IV, 0.27 mm.; V, 0.23 mm.; VI, 0.09 mm.; VII, 0.41 mm.; total length, 1.67 mm. The third joint has about twenty-four moderate-sized, irregularly-placed circular sensoria. The fourth joint has two or three sensoria on its basal half. The usual one is present near the distal end of the fifth joint. A cluster of about six or seven small ones are present at the union of the sixth and seventh joints. The frontal tubercles are each developed into prominent projections, which are equal in length to the front joints of the antennæ. The eyes are very dark red in color, and the ocular tubercles are small. The ocelli are not conspicuous, but three in number. The beak is brownish and 0.27 mm. long, extending to the mesocoxæ.

The prothorax is short; the thorax is black, strongly arched, and broad. It is so much arched that the prothorax can scarcely be seen from a dorsal view. The wings are hyaline, with brownish black veins. The stigma is grayish, 0.145 mm. wide and 0.63 mm. long. A peculiar fold lies between the costal and subcostal veins of the caudal wings, which is designated in the figure. Total wing expansion, 5.80 mm. Legs are brownish black, hirsute; distal half of the femora, distal part of the tibia and all the tarsi black. Legs rather long in proportion to the body.

Abdomen is dark brown. Honey-tubes concolorous, almost cylindrical, and 0.32 mm. long, or three times the length of the tarsi. The style is black, hirsute, conical, and 0.09 mm. long, or about one-fifth the length of the honey-tubes. Total length of the body, 1.09 mm.

This form was taken in October, and since only one specimen was taken no adequate description or habit can be given. It was found in company with *Schizoneura corni*, on the ventral side of the leaves of the elm (*Ulmus americana*).

THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 2—October, 1905.
(Whole Series, Vol. XIII, No. 2.)

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PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 2. OCTOBER, 1905. { WHOLE SERIES, VOL. XIII, NO. 2.

THE COCOONING HABITS OF SPIDERS.

BY THEO. H. SCHEFFER.

INTRODUCTION.

THIS treatise does not aim at anything like a complete survey of the subject. The field is large, and the time spent by the author in going through its descriptive literature would not justify any assumption of completeness in the results gleaned. Then, too, the period of actual investigation prosecuted in the spiders' territory covered only a portion of one season—from August to December—among Eastern forms, and a single year among the spiders of central and western Kansas. Although in that limited time and in the two restricted districts it was possible to verify some of the statements or conclusions of writers on the subject, and to add something to existing knowledge, it is evident, at least to the writer, that several seasons' investigation in a wider range of spider territory should have preceded the preparation of a paper on this subject. However, the haunts of the Araneida are not forbidden ground and the investigator who is so disposed may add to or subtract something from this if he choose.

In general, the discussion will be confined to species included in the fauna of temperate North America, but characterizations of the habits of families will be drawn from these groups at large. The system of classification worked out by that veteran French writer, E. Simon, in his recently completed "Histoire Naturelle des Araigneés," will be followed in all cases where it has been possible to establish identity from the synonyms.

Of the twenty-five families of spiders assigned to temperate

North America by Simon, two, Hypochilidæ and Prodidomidæ, are very sparsely represented, and nothing is known of their cocooning habits. Some general statements can be made in regard to the habits of all the others, but in many cases no specific types can be cited. It is usually difficult, however, to say much in a general way about the habits of a family, for the larger subgroups sometimes take the liberty of differing widely among themselves in respect to methods of cocoon fabrication and care of eggs and young.

The term "cocoon," as used in this article, refers always to the silken sack used to enclose the spider's eggs. This explanation seems necessary, because in entomological discussions the word usually designates the case in which an insect undergoing metamorphosis passes its pupal life.

All type descriptions, with three or four exceptions, are based on personal observation. In the case of these exceptions credit is given to the observer.

GENERAL DISCUSSION.

Among all the creeping things none deserve less the popular odium and the ill reputation that attaches to them than the spiders. Superstition ascribes to them artful ways and dark designs; literature associates them with gloomy dungeons and venemous reptiles, while common ignorance invests them with various and sundry undesirable qualities. This is surely hard luck. The outcome of it is that the average newspaper correspondent lays at their door the death of every citizen whom a mysterious providence afflicts with septicemia—resulting from scratches—and children are taught to shun or destroy these interesting little spinners who could teach them more in a minute than an ant could in a week.

Although it is true that spiders will have to plead guilty to a natural ferocity that condemns each one to a solitary existence, and even adds the risk of life to the addresses of courtship, only a lack of knowledge concerning their habits can account for the low esteem in which they are generally held. Familiarity with their works and ways tends to raise these humble spinners many notches in the scale of our estimation. Certainly no class of insects, that nearly related group comprising more species than all the rest of the animal kingdom together, presents more interesting traits in a general way or shows more tenderness and solicitude in the care of its young than the Araneida. If it were the purpose of this article to defend the spider's reputation, much could be said that would tend to enhance our respect for them, but the limitations of the subject will permit discussion of their conduct along one line only.

Spiders interest themselves in various spinning operations; they make snares to trap their prey, silk-lined habitations to shield them from rough weather, drag-lines to serve as bridges and ladders, balloons to bear them aloft in their autumnal flights, fetters to bind the larger insects they capture, and silken sacks in which to enclose their eggs. The use of silk for this latter purpose seems to be almost universal, although many species omit one or more of the other industries from their line of practice. Many spiders use their silk for cocoon fabrication only.

The majority of spiders live but one year, and in their period of maturity each female makes but one cocoon to enclose her contribution to the perpetuation of the species. There are, however, many exceptions to this general rule. Some spiders are known to live several years, probably rearing a brood each season, and a number of quite common species, as the Labyrinth spider and the cobweb weaver of our house and outbuildings, lay their eggs at intervals during the summer, adding a cocoon each time to the collection or string.

In texture the egg-sacks vary from a simple mass of loose floss, through which the eggs can plainly be seen, to a structure whose walls are like parchment, close-woven, and stiff enough to protect the contents from rain and frost through the long, dreary months of a New England winter. The former class is represented by the cocoons of some of our common orb-weavers, such as those that stretch their webs between the timbers of bridges; the latter class is typified by the egg-sack of the Golden garden spider, a familiar object in the late autumn.

The modifications of structure to adapt the cocoon to season or environmental conditions are very obvious. Cocoons which are made for summer use only, or are sheltered in some way or protected by extraneous material, are less compactly woven than those meant for wintering eggs or young or those which occupy exposed situations. Again, the composition of the cocoon will depend to some extent on the care the mother spider is to give it after the eggs are enclosed. Some species die shortly after they lay their eggs, leaving the latter to the vicissitudes of fate. This is especially true of those that mature in the fall, as do the majority of the orb-weavers; other species, particularly of the jumping spiders, stand guard over their treasures until the young emerge; while still others carry the cocoon about with them, clasped in their pedipalps or attached to the spinnerets. The least observing student of nature has no doubt quite often seen instances of this latter habit in the spring or early summer, when one may find the running spiders with their cocoons in the grass or under stones. A little later the young emerge and climb upon the mother's back, where they cling for a week or so, until they can shift for themselves.

The sites chosen for a fixed cocoon seem also to have some reference to the mother's future intent. Cocoons that are to be the objects of her watchful care are usually placed near the spot she has chosen as an abiding-place—in the snare, if she makes one, in the burrow or dwelling-tube, or in an incubation cell made expressly for the purpose. On the other hand, species that do not survive cocooning will go some distance to find a secluded spot under stones or bark, or in a rolled leaf. The protection of the cocoon in such cases, or occasionally even when guarded, involves the use of various extraneous coverings. Sometimes bits of dead leaves or sticks are employed; at other times fragments of captured insects, like trophies of victory, serve the double purpose of adorning and hiding the cocoon. Often fine earth or, still better, a mortar of clay completely hides the silken sack. Cocoons of this sort, as well as some others, are frequently suspended by a slender pedicle from a convenient support.

The parts of a cocoon seem to require separate mention. There are two types of outer envelope—one consisting of an entire, homogeneous piece, and one made up of two valves united at a more or less circular suture. This suture may be scarcely noticeable, or it may be a plainly marked zone of weaker tissue that stretches to make room for the young brood, and finally ruptures to permit the egress of the spiderlings. The method of manufacturing such an egg-sack is simple. A circular silken sheet of the proper size is woven, and upon this the eggs are laid. Another similar sheet is then spun over the eggs and the two are united by their overlapping edges. The result is a biscuit-shaped affair in some cases; in others a cocoon that is almost perfectly globular. These are the portable cocoons referred to above. Within the outer envelope of the homogeneous type of cocoon may be one or more others, and on the inside, surrounding the eggs, is often a quantity of fluffy packing.

The contents of the cocoon next claim a share of our attention. Three conditions of the egg-mass obtain among the various species of spiders—the eggs may be free to roll about like so many dry peas, they may be entangled and held together by fine threads of silk, or they may be glued together into a more or less compact ball by a viscid secretion that hardens as it dries. This last condition seems to be an especially favorable one in which to pass the winter. Evidence of this is supported by the egg-masses of *Araneus trifolium* and the Spectacled spider of the East, which are not only held together but covered with a limy looking secretion.

The number of eggs varies greatly, depending largely, no doubt, on the chances for hatching and survival of the brood. We accordingly find the number greater when the eggs must pass the winter unhatched, or when they are not guarded by the mother spider. That this is not always true, however, is shown by the fact that some spiders whose eggs pass the winter without hatching lay but a few. The Triangle spider, for instance, encloses less than a dozen eggs in her compact, scale-like cocoon; but the latter is rendered so secure by reason of its protective coloring, in addition to other things, that probably nearly all the eggs hatch in the spring. Certain spiders which carry their eggs about, or shut themselves up in a cell with them, lay not more than three to five. The other extreme is represented by species such as *Argiope aurantia*, whose cocoons, containing from 1000 to 1200 eggs, hang unprotected from the tops of dead goldenrods through the storms of winter.

The large, burrowing Wolf spider, which sometimes lives in our gardens, lays from 500 to 600 eggs, enclosing them in a globular cocoon. For this treasure the mother will fight desperately, refusing to surrender or desert it even when her legs are torn from her body. Her devotion is born of instinct, however, and not of reason; since it is an easy matter for an observer to impose upon her lower order of intelligence by substituting a bogus cocoon of pith. This she will regard with the same marks of tenderness she bestows upon the silken sack freighted with the hopes of her posterity.

In color the eggs show some variation among the species. The prevailing tints are whitish or yellowish, though shades of red and brown are not uncommon. Even violet tints are ascribed to the eggs of certain species.

With spiders, as with animals of higher and lower types, the operation of the laws of natural selection begins with the eggs. These become the food of other spiders, or of birds and predaceous insects. Thus their numbers are greatly reduced. Out of 600 cocoons of *Argiope aurantia*, collected by Professor Wilder on one occasion, less than 150 were entire, the others being torn or pierced. Parasitic Hymenoptera of several species also seek out the cocoon, puncture the walls, and lay their eggs there, so that their larvæ when hatched may find a supply of food at hand. In the autumn months it is the exception, rather than the rule, to find, in some classes of cocoons, one that is not parasitized. The spider's revenge occasionally comes in the form of a secondary parasite, that, in turn, treats the first invader as she had treated the original cocoon builder.

When the young spiders have hatched their troubles have only begun. In addition to the dangers that threaten the eggs others await them. For example, if we are to accept the doubtful conclusions of some observers, they have to be on the watch lest they fall a prey to the appetites of their larger and stronger brothers. Cannibalism within the cocoon is, however, not an established fact; more evidence than that already gathered is necessary to prove that it exists.

Field observation reveals the fact that spiders pass the winter in one of three states—in the egg, as already referred to, as newly hatched young in the cocoon, or as half-grown spiderlings and adults in various shelters. Ordinarily, in summer, the eggs hatch in from fifteen to thirty days, the time varying with the species, but when they are laid in the autumn they may not hatch until the following April or May. Of course, only those young which hatch in the warm season and emerge from the cocoon soon after can receive any care from the mother spider. That such broods are cared for with the greatest tenderness and solicitude is a matter of common observation among such families as the Lycosidæ, the Dictynidæ, and the Salticidæ. In the first of these families the young remain with the mother for as much as two weeks, being carried about by her as they cluster on her back. The salticids seal themselves up in a silken sack with the eggs, and when the young hatch remain with them for a long time. The young dictynids occupy the maternal snare for weeks, and without doubt are afforded some protection and material help. Further observation will most certainly establish the fact that spider mothers of many species capture and bring food to their young, as do birds to their nestlings.

DISCUSSION BY FAMILIES.

Family AGELENIDÆ.

This is a family of sheet-web weavers, represented in our fauna mainly by the two genera, *Agelena* and *Tegenaria;* the former found in open, grassy fields, the latter in sheltered places, including barns, cellars, and outbuildings. There is some difference between the two genera in cocooning habits. Species of the genus *Tegenaria* construct cocoons whose exterior envelope is homogeneous and continuous—not made up of two valves. These cocoons number two or more usually, and are in the shape of a flattened ball or are nearly globular. They are placed either in the web, being suspended from it, or on some object near the web. Sometimes this object is a little silken hammock made especially for the purpose. It is very common, also, to find the cocoon covered with bits of plaster, clay, or debris of some sort. This habit of garnishing the cocoon on the outside, or that of putting dirt between some of the envelopes, seems to obtain throughout nearly all the genera of the family.

The cocoon of the genus *Agelena* is more flattened, generally plano-convex. It separates, when one attempts to tear it, into two valves—a lower, silken rug or pad on which the eggs are placed, and a covering of two or more layers of floss separated by foreign debris. It is ordinarily attached by the plane face, but Miss Staveley reports a species (*Agelena brunnea*) that suspends it by a stalk from a twig. Some species place the cocoon in a closed cell in or near the web, while others lodge it in sheltered places remote from the snare.

Beyond making careful provision for the seclusion and protection of her eggs, the agelenid mother can do nothing for the next generation, as she rarely lives to see her offspring. The females of most species die in the fall or early winter. *Tegenaria civilis*, however, is known to live four years, producing many broods (Staveley).

TYPE: **Agelena nævia.**

This is a very common species, which makes its sheet web, with funnel retreat, in grassy fields, in brush piles, or in nooks and crannies in and about buildings. The eggs are laid in September and October. At this time the females collect together in great numbers under the bark of dead trees or fence-posts, under loose rocks, and in angles of buildings and like places. Here their cocoons are grouped so close together as to often overlap—as many as forty or fifty sometimes being found on a space as large as one's two hands. The cocoon itself is a low, hemispherical patch, approximately three-fourths of an inch in diameter, attached by the flat face. Sometimes, also, the highest point of the convex surface is attached. It is white in color, and one can readily distinguish the following parts: A closely woven rug on which the eggs are placed, over that a circular covering, and then two more light silken blankets, with a layer of dirt or wood chippings between. This layer of debris shows through the outer covering as grayish protuberances. The dead bodies of the females are usually found on or near the cocoons. The eggs are cream-colored, not agglutinate, and number about 200. The young hatch in the early spring, and leave the cocoon some time in April.

TYPE: **Coras medicinalis.**

A species very frequently met with the year round. It lives in sheet webs under rocks, tangled masses of roots, overhanging banks, and other like shelters in the woods. The cocoons are spun in early summer. In all cases noted they were suspended, or rather entangled, in the web, which was drawn up at the edges and sagged somewhat in the center. This sagging is caused by a mass of fine, dry dirt, bits of leaves and other trash held together by a loose outer spinning work enclosing the cocoon proper. The latter is nearly spherical, about one-half inch in diameter, and has more dry dirt interwoven in its envelopes. The inside is soft, cottony, and pure white. It contains about 125 white eggs, which are not agglutinate. The mother spider remains in the web with the cocoon, carefully repairing any damage to the supports of the latter.

Family ARGIOPIDÆ.

It would not be practicable, or perhaps even possible, to say anything in a general way about cocooning habits in this family. It is by far the largest group of Araneida, and its numerous species have been arranged in very many subfamilies and supergenera, some of which are themselves larger than other entire spider families. We can, however, arrive at some knowledge of the diversified cocooning habits of these orb-weavers by a comparative study of a number of types.

TYPE: **Araneus labyrintheus.**

The Labyrinth spider spins, in addition to the regular orb, a barrier web consisting of a maze of intersecting lines. Near the top of this labyrinth the female fastens her string of five or six cocoons. The first of these is spun about the middle of August, and the others added at intervals until late in October. When the leaves have fallen and the early winter winds have torn the webs to shreds, the strings of cocoons can easily be found attached by three or four tightly stretched lines radiating to the tips of twigs on bushes or low trees. These supporting lines are strong enough to sustain the weight of the branch to which they are attached, when the latter is broken off. The cocoons are placed so close together as to overlap for half their width, and the whole string is usually protected by bits of leaves or a light silken sheath. Each cocoon is composed of two valves—a short, oblique, conical case for the eggs and a slightly convex cover, about three-eighths of an inch in diameter, for the same. Both basal portion and cover are of paper-like texture, the former light brown in color, the latter gray. The eggs are further protected by a light packing of fluffy brown silk in the interior of the case. They are yellowish red, adhere slightly, and number twenty-five or thirty in each cocoon. The young spiders hatch in the fall, but remain in the cocoon until the following spring. In November one may find strings in which the older, upper cocoons contain young spiders with color markings, the intermediate cocoons pale, newly hatched fellows, while the lower cocoons still have eggs. The mother spider maintains her position immediately below the lowest cocoon of the string. She disappears, however, at the approach of winter, and probably perishes.

TYPE: **Araneus trifolium.**

This is one of the largest of the orb-weavers. The web is stretched between two bushes or tall weeds in some wet, shrubby pasture. I have not been able to determine the cocooning site, although I have searched carefully on several occasions. During the last week in September and the first week in October I secured a number of cocoons from females imprisoned in the college insectary. They are inverted-dome-shaped affairs, a little greater in depth than a hemisphere, and with the base slightly convex. One of the largest measured one and one-fourth inches across this base and had a depth of about one inch. They are formed of a single bunch of loose, flocculent material, somewhat firm on the outside, but transparent enough to show the large egg mass within. All were attached by the base to the top of the large breeding cage or to the potted plants enclosed therein. They are white in color. The egg-mass is subspherical and very compact, being glued together, and partly covered by a white, limy secretion. There are several hundred yellowish eggs in each cocoon. After laying her eggs the mother spider, very much shrunken in appearance, soon dies. The eggs probably do not hatch until spring.

TYPE: **Araneus frondosus.**

Perhaps the most common orb-weaver in the East, spinning webs on fences, bridges, or bushes. The cocoons are attached in the angle of timbers close to the web, or, occasionally, to the side of a leaf whose edges are partially drawn together. They are roundish or oval masses of fleecy white silk, held in place by a maze of short radiating lines fastened to the leaf or angle of timbers by attachment disks. They approximate an inch in most dimensions and contain several score of pearly white eggs.

These are slightly agglutinate, and are placed on a felt-like rug somewhat denser in texture than the rest of the cocoon. The young broods are produced late in the summer. I have found some in the egg state and some just hatched the first week in September. The cocoon is too loose to afford much protection, which probably accounts for the spiderlings leaving it early in the fall to spend the winter elsewhere. The adult females are seldom seen about their cocoons, and they disappear entirely at the approach of cold weather.

TYPE: **Meta menardi.**

A spider dwelling in caves, tunnels or dark recesses among the rocks on the side of a gorge. The cocoons are pear-shaped affairs, about seven-eighths inch and five-eighths inch in longest and shortest diameter respectively. They are of pure white, filmy tissue, so transparent that the egg mass can be photographed through the outer envelope by transmitted light. They are suspended by a sort of neck or short pedicle from the roof of the cave. The female remains on or near the cocoon for some time after depositing the eggs. The latter form a small yellow ball, a little more than one-fourth of an inch in diameter, held together by fine threads of tangled silk. They are apparently not agglutinate. They number 300 or 400. The cocooning season for this species is, in the neighborhood of Ithaca, N. Y., the latter part of August and the early days of September. The young spiders soon hatch, but remain in the cocoon through the winter.

TYPE: **Theridiosoma gemmosum.**

The Ray spiders live a retired life along the banks of some creek, where overhanging bushes and projecting rocks afford the gloom they seek. In such locations, especially in the dark recesses under clusters of roots, we may look for their cocoons in midsummer. They are among the most interesting to be found; little golden brown balls, about one-eighth inch in diameter, suspended by a single glossy white thread nearly an inch long. They are paper-like in texture and are attached to this stiff, silken pedicle by a dilation of the latter in the form of a cone. At the time of hatching this little cone lifts up like a lid, adhering by merely a point of the circumference and uncovering a small, circular hole through which the young escape. The pedicle itself usually hangs suspended from two or three cross lines of silk attached to surrounding objects. From some cocoons collected August 23 the young spiders emerged August 28. Data respecting the eggs are not at hand.

TYPE: **Tetragnatha extensa.**

This spider is abundant in the prairie regions. It does not seem to have the preference for living near water shown by other species of the genus, as it is found on the higher hills as well as along the streams. The cocooning season is early in the year, the species being one of the first orb-weavers to appear in the spring. In the month of May the interesting little cocoons can be found swung by their supporting lines from some convenient object. They are about the size and shape of a cherry-pit—aproximately one-fourth inch in diameter. Each is composed of loose material of a greenish tinge and is covered with projecting tufts of whitish silk. The suspending lines, usually three in number and about an inch in length, support the cocoon like a hammock. They are stretched so tight as to be nearly horizontal. The eggs are agglutinated into a little ball looking like a tiny berry. They are whitish, tinged with brown, and number about sixty. In some cocoons young spiders were found May 20.

TYPE: **Argiope aurantia.**

The Golden garden spider spins its snare in about the same situations as those chosen by *Araneus trifolium.* Its cocoons are easily found in autumn among the goldenrods in or near some marshy place, or down in the matted grass of the marsh itself. They are large, bladder-shaped sacks, a little more than one inch in longest diameter, and having a narrowed neck, to the flaring top of which attachment is made with the lines that support them. They are also held in place by a maze of radiating threads which draw together the leaves and stems of the supporting plant in such a way as to hide and protect the cocoon. The exterior of the cocoon is light brown to dark brown in color, and paper-like in texture. The egg-mass within is again enclosed in a capsule of firm brown tissue, elongate-dome-shaped, with base of dome upward, slightly convex, and consisting of a felt-like, reddish brown rug, which detaches readily from the other valve of the capsule. Above and below this capsule are masses of brown silk packing. The eggs are yellow, agglutinate, and number from 1000 to 1200.

The egg-laying season begins late in August and continues through a part of September. By the middle of the latter month most of the females, after making provision for the perpetuation of the species, have perished. A few may be found, however, as late as October. The eggs begin to hatch the last of September, but the young remain safely ensconced in the cocoon until the following April or May. The large number of spiders that hatch in the fall has been greatly reduced by the time they emerge in the spring. This circumstance has led some investigators to believe that the inmates of the cocoon resort to cannibalism during their long winter wait. Hymenopterous parasites infest numbers of the cocoons, and a great many others are torn open, apparently by birds.

TYPE: **Argiope trifasciata.**

The Banded Argiope lives, by choice, in grassy ravines or meadows, where her web, with the zigzag band across the center, is a common sight in the autumn. The cocoon, of closely woven silk, is fastened by radiating threads among the stems of grass close to the abandoned web. It is well down toward the roots of the tangled grass, and is thus not easily found. It is shaped like a kettle-drum, having a flat top nearly three-fourths of an inch in diameter, and an inverted-dome-shaped base of about the same depth. The head of the drum is a circular brown patch that separates readily from the base. Above it projects a scalloped border furnishing attachment to some of the supporting lines. The color of the base is a sort of tan or cream yellow; it is firmer in texture than the head.

The egg-laying season is later than that of *A. aurantia.* Although two cocoons were secured in the laboratory as early as September 15, none could be found in the fields until the last of October. On the 24th of that month the majority of the females were still in their webs, their abdomens distended with eggs. Two weeks later they had nearly all disappeared and cocoons were plentiful. The eggs are cemented together into a mass nearly as large as that of *aurantia.* They are yellow, and number several hundred. The young hatch in the early winter but remain in the cocoon until spring. In many cases parasitic Hymenoptera were sharing their winter house.

TYPE: **Cyclosa conica.**

In midsummer we find the cocoons of this small orb-weaver arranged in a string across the center of its vertical web. The string is also partly made up of nodules of silk, trash, and fragments of insects captured by the spider. At the lower end is the tenant herself, scarcely distinguishable from the other elements of the string. The cocoons may be separated by short intervals, or placed so close together as to touch or even overlap slightly. They number from three to five, are elliptical or double-cone-shaped, and are of a yellowish-brown color. Each consists of a single piece of floss, approximately one-fourth inch long and one-eighth inch wide, and close-woven enough to be weather-proof. There are from ten to twenty-five bluish-white eggs in each cocoon of the string. These are not agglutinate. Contrary to the arrangement in *Araneus labyrintheus*, the upper cocoon is the newest one, and may contain eggs while the lower ones are occupied by young spiders.

Family SALTICIDÆ.

The salticid family presents some interesting phases of maternal instinct not found among the orb-weavers. This must necessarily be so, since the mother usually survives the act of ovipositing and watches over the eggs and young, while the orb-weavers, as a rule, perish after laying eggs. Cocooning takes place earlier in the season than is common among the Argiopidæ, so that by the time winter sets in the young are well grown, and spend the cold months snugly ensconsed in silken bags of their own fabrication. In midwinter one may find these bags under stones or bark and in crevices of wood. In some such situations, and also in the seed-tops of weeds and grasses or in clusters of leaves, we find their cocoons in spring and summer. They are always enclosed in an outer sack, in some cases the one in which the female spent the winter. Being thus enclosed they are rather frail, and may be merely pockets in the sides of the dwelling-tube. They are usually, however, lens-shaped affairs, suspended, like a hammock, from its walls.

There may be three or four such cocoons, but more commonly only one. The females remain in the cell with the cocoon during the period of incubation, and until the young are ready to leave the parental nest. In many species they even seal up the cell from the inside, that no marauder may intrude.

TYPE: **Phidippus ferrugineus.**

This large black and rust-colored species I have found only on the limestone hills of central Kansas. The female passes the winter in an oval dwelling-sack of stiff, closely woven tissue, arched on one side, the other flat, and attached to the under surface of a loose stone. Small sticks and bits of leaves are used to partly cover the sack, or at least to surround its base. There is no opening for egress. In April the occupant spins a cocoon of fleecy adhesive silk, attaching it to the walls of the sack. It is depressed spherical or biconvex lens-shaped, pure white, like the sack, and about three-eighths of an inch in greatest diameter. Immediately investing the eggs is an inner envelope of somewhat firmer silk, about as thick and smooth as ordinary tissue paper. The eggs are yellow, not agglutinate, and number about 140. After they hatch the young remain sealed up in the sack with the mother for at least two or three weeks.

TYPE: **Phidippus opifex.**

This species, from California, makes its cocoon nest in some shrub, as sage. It is an egg-shaped mass of white spinning work, about three inches long by two and one-half broad—sometimes less. In August or September the mother spins in this nest from two to four white, lenticular cocoons for her eggs. They are attached to the walls, and shut off from the part of the nest the mother occupies by a thin sheet of web. Each consists of a shallow concave disk on which the eggs are placed and a convex cover for the same fastened down by a few loose threads at the junction. The eggs are pinkish red in color. The young are said to remain in the cottony nest until spring (Davidson).

Family ATYPIDÆ.

Four genera, including six species, of this family of burrowing spiders are accredited to temperate North America—these mainly on the authority of Simon or Hentz. Little has been recorded concerning their cocooning habits, and, as they are found only in the South or on the Pacific coast, I have had no opportunity to observe them. I present two somewhat conflicting statements relative to the genus *Atypus*—all I could find on this family. "At the bottom the burrow widens out a little in the form of an oblong chamber, and it is at the entrance to this chamber that the female suspends her cocoon, which has the form of a little sack of white, closely woven material" (Simon). "The female deposits her cocoon at the end of her burrow; this is guarded from the dampness of the earth by being placed on a cushion formed of silky flock and the fibers of plants" (Staveley).

Family AVICULARIIDÆ.

Considerable has been written about the interesting habits of these Trap-door spiders of the West and Southwest, but most of the writers seem to have neglected observations with which this paper is concerned.

When the egg-laying season arrives, many species of this family completely close up their burrows by sealing the trap-door to the walls. The single cocoon containing the eggs is then suspended near the bottom of the tube or in one of the chambers, if it has diverticula. The cocoon is a fairly close-woven sack in some species, but in others, particularly of the genera *Bothriocyrtum* and *Cteniza*, the eggs are held in place merely by a few threads. Members of the subfamily Aviculariinæ, like species of the Pholcidæ and Pisauridæ, carry their large, rounded, flabby cocoons about in their cheliceræ until the time of hatching. The young, as a rule, remain for some time in the burrow with the mother, but at an early age are said to build perfect trap-door nests for themselves.

Family CLUBIONIDÆ.

This is a large family, including a number of groups that differ considerably from one another in cocooning habits. With all the diversity, however, the general methods of procedure will usually follow one of three lines. The most common practice is to enclose the more or less lens-shaped cocoon in an outer dwelling-sack, or special incubation cell, like most of the Salticidæ. In a few cases this outer sack is a mere veil of silk, but more often it has thick walls of double or triple tissue, and may have, in addition, foreign material added for protection. When tube-shaped it is spun in crevices of wood or bark, in stone fences, or in rolled leaves. When larger and more globular it is usually enclosed in a tent of leaves drawn together. In one subfamily, at least (Sparassinæ), the female shuts herself up in the dwelling-sack, with the eggs. In other groups the sack has one or two openings, allowing the mother spider to perform sentinel duty and at the same time to pounce upon stray insects for food. The female in some species is said to defend her nest to the last; in others to leave it at the approach of danger.

In contrast to the above practices, some members of this family merely spin upon rocks or wood a plano-convex cocoon attached by the flat face and having no outer protecting tent. The cocoon itself, in this case, is of strong, paper-like tissue. It is probable that a great many of the dry, parchment cocoons we find on the sides of rocks belong to the genus *Agroeca.* Females of the supergenus Cteneæ are said to guard the otherwise unprotected cocoon.

A third method of procedure is that adopted by the Heteropodeæ. All members of this group that have been observed carry their cocoon about with them, holding it close to the sternum by means of the cheliceræ and pedipalps. The cocoon is disk-shaped and of rather firm tissue.

TYPE: **Trachelas tranquilla.**

Females of this species can be found under bark or in woodpiles. In such situations they spin their cocoons in September and October. The cocoon consists of a low, dome-shaped cap, resting upon a flat disk, which projects beyond the edges of the convex piece so as to form a narrow border. This disk is firmly glued to the surface of the wood or bark. Including the disk, the cocoon is about three-eighths inch in diameter. When first spun it is pure white, glossy, and of paper-like texture. These qualities are not long apparent, however, for the mother covers the entire surface with chewed bits of bark and then spins a light web over the whole. The eggs, thirty or forty in number, are creamy white and slightly agglutinate.

TYPE: **Heteropoda regia.**

The Huntsman spider lives in the sunny South. Specimens sometimes find their way North in bunches of bananas, and inhabit the warerooms in which the fruit is stored. The female of this species, solicitous for the welfare of her progeny, carries the egg-sack about in her cheliceræ, clasped to the sternum. It is a sort of flat, biscuit-shaped affair of two pieces, joined at the circumference. One of the slightly convex surfaces is of paper-like texture, the other a little looser. I have made no further observations upon this species, except to record the finding of a female carrying a sack of eggs on May 29.

Family DICTYNIDÆ.

An interesting family of small, curled-thread weavers. The females show especial solicitude for the welfare of the young, remaining with them in the tangled web, which contains the cocoons, for several weeks after they hatch. It is more than likely that during a part of this time the mother spider supplies them with food; in fact, I have on more than one occasion observed the young of *Amaurobius sylvestris* swarming over and apparently feeding on a fly which the mother had just captured. The cocoons are always little button-shaped affairs, less than one-fourth inch in diameter, attached by a few threads to twig, leaf, woodwork, or stone wall, or enclosed in a little tangle of curled silk in the top of some dead weed. Each spider spins several of these, rearing her broods at intervals during the summer.

TYPE: **Dictyna volucripes.**

This species makes its little irregular web in the seed clusters or tops of weeds. Here the cocoons are placed. Sometimes only one is found; sometimes four or five. Each is button-shaped, about one-eighth inch in diameter, and consists of two slightly convex pieces joined at the circumference. They are pure white and of a texture about like that of thin blotting-paper. I have found cocoons containing eggs from the latter part of June to late in September. The average number of eggs in a cocoon is somewhere near fifteen. They are yellowish white and apparently slightly agglutinate. The mother spider is invariably found in the web with the cocoons. It is evident that she remains there while one brood after another hatches, grows, and disperses. All, adults and young, have disappeared by the time winter arrives.

Family DRASSIDÆ.

Members of the family Drassidæ usually live on the ground, under stones or trash. Two general methods of cocooning seem to obtain. Species of the supergenus Drassodeæ make a flattened cocoon, as, in fact, all drassids do, but, unlike that of other genera, it is equally convex on both sides. In further contrast to that of the other main group in this family, the cocoon is always white and more or less firm, but never paper-like nor glossed. In addition to the cocoon, these spiders construct, in shallow holes under stones, a silken bag to contain the former. The cocoon may be loose in this nest, or it may be attached to the stone, which, lined with silk, forms one side of the dwelling-sack. The female remains on guard inside until some time after the young have hatched. In a few cases they do not thus enclose the cocoon, but watch it from a retreat near by.

In some other genera, as *Pœcilochroa*, *Megamyrmecion*, and *Melanophora*, the cocoon is plano-convex and attached by the flat face. The other face, convex in the center, becomes flat on the border, forming a circular margin. These cocoons are very firm, parchment-like, and glossy. Though commonly white, they are sometimes pink, or even red. They are not enclosed in any nest or sack, but in some cases, at least, are guarded by the female. Spiders of the genus *Gnaphosa* make no sack, but some envelop themselves in a light web at the time of laying eggs. They watch over the cocoon, which is not stiff and glossy in texture, like those mentioned above. Species of *Herpyllus* sometimes place dirt between two layers of silk in the cocoon, or cover the outside with some material resembling the stone to which it is attached.

TYPE: **Drassodes neglectus.**

Early in May males and females of *D. neglectus* are common in mating-sacks under stones, the males having matured two or three weeks before the females were sexually developed. Later in the month and in June one may find, in the same locations, their cocoons cradled in light silk hammocks. They are biscuit-shaped sacks, a little over three-eighths of an inch in diameter and about one-fourth inch thick, of a texture like thin, flabby, tissue paper. Of the two component valves, the one resting upon the web is flatter and smaller than the other, which is more convex and has a sort of boxed edge. The suture at the junction of the two valves is quite distinct. The eggs, about 100 in number, only partly fill the cocoon. They are whitish and not agglutinate. In every case that came under my observation the mother spider was resting upon and clasping the cocoon.

Family DYSDERIDÆ.

We have but three or four species of this family of spiders in the United States, and these are not common. Members of the genus *Dysdera* shut themselves up in a flattened, oval case to deposit their eggs. This case is white, firm, and often covered with sand or other extraneous matter. According to Simon, the eggs are not enclosed in a special cocoon ; merely deposited within the dwelling-sack occupied by the female. In the genus *Segestria*, however, a lens-shaped cocoon of closely woven white tissue is placed in a special incubation cell near the dwelling-tube of the mother spider. As in the case of *Dysdera*, this cell is usually covered with foreign material which adheres firmly to it. The genus *Ariadne*, represented by *A. bicolor*, spins its cocoon in a long dwelling-tube. After hatching, the young remain with the mother a short time.

Family FILISTATIDÆ.

Only a single genus, including two rare species, is found in our country. Simon describes the cocoon as "flattened, flocculent, and entangled in the midst of the web, like that of *Amaurobius*." The cocoon of *Filistata hibernalis*, according to Hentz, is spherical.

Family LEPTONETIDÆ.

One genus, *Usofila*, is said to be represented in temperate North America. The females of the foreign genus *Ochyrocera* have, like *Pholcus*, the habit of carrying their eggs in their cheliceræ. These eggs are held together merely by a few threads.

Family LYCOSIDÆ.

The Wolf spiders are represented in temperate North America principally by the two genera, *Lycosa* and *Pardosa*. Many species of both frequent the water exclusively, hiding under stones along the shores of creeks. No other group presents so many interesting phases of the subject under discussion in this paper. All the Lycosidæ, without exception, carry their cocoons suspended from the spinnerets by a few threads of silk. The larger species, when the duties of maternity devolve upon them, become more sedentary than at other times, cease to rove about, and usually excavate a shallow hole or burrow under a rock for a temporary nursery. This retreat they line with silk, and there they remain for a season, rarely leaving home except to capture food near by. The smaller species, on the other hand, wander about as usual, dragging their cocoon with them on the chase. They make no retreat of any kind, and use their silk only for enclosing the eggs.

When the young lycosids hatch they climb upon the body of their mother, clinging fast on all sides by means of tiny threads which they stretch among the hairs. Thus encumbered the female presents an odd appearance, as though she had increased in bulk to twice her ordinary size. The young remain with her for perhaps two weeks, at least until after the second moult. If she be disturbed by an observer the spiderlings scatter in all directions.

The cocoons of the species of *Lycosa* are nearly globular, those of the *Pardosæ* more flattened. In either case they consist of two valves united by a suture, forming a belt of finer tissue, which, in the latter group, is usually quite conspicuous, being lighter colored. Along this zone the two valves separate when the young hatch. The mother is said to aid their egress by biting the threads. Maternal solicitude is very evident in the care bestowed upon the cocoon while the eggs are yet unhatched. If this precious sack be torn from the mother, she will rush about frantically in search of it, and when she finds it again will eagerly grasp it and make off for a place of safety. After a time, if undisturbed, she will again attach it to her spinnerets.

Type: **Lycosa carolinensis.**

This is probably the largest species of the family. In the West it has burrowing habits, digging down into the prairie sod to a depth of eight or ten inches. Individuals probably live two or three years, as half- or two-thirds-grown specimens may be taken at any time. In the cocooning season—May and June—the females never roam about, at least not in the daytime. When found with a cocoon they are always in the burrow. The males, however, are frequently seen near the mouth of a burrow or running about. The cocoon, which is attached to the spinnerets of the female, is almost perfectly globular. It varies in size from one-half to three-fourths of an inch in diameter, and is composed of two valves overlapping at the suture. The envelope is quite tough, and is, perhaps, originally white, but all cocoons appear soiled from contact with the damp earth. They enclose from 500 to 600 eggs each. These are not agglutinate. The mother spider valiantly resists any attempt to deprive her of her treasure. When the young have hatched they cluster over her body in such numbers as to make her appear as large as a small mouse.

Type: **Pardosa lapidicina.**

A very common spider in the West, frequenting the vicinity of streams, ponds, or gullies. They run swiftly, carrying the body high above the ground on their long legs. The cocooning season seems to cover the greater part of the summer, as females with egg-sacks have been observed from April to August. The cocoon is attached to the spinnerets ordinarily, but, as with the species of *Lycosa*, if it be torn loose the mother will carry it about in her mouth-parts for some time, finally attaching it again by threads. It is biconvex-lens-shaped, one-fourth inch in diameter, and a little over one-eighth inch between the convex faces. It consists of two valves, firm and paper-like, which overlap slightly at the suture. The color is bluish green or bluish drab at first, but this soon fades. Bulging protuberances indicate the crowding of the eggs within. The latter number about 100, are cream yellow in color, and not agglutinate. After hatching, the young are carried about for some days before they escape from the cocoon. After this the mother's back serves as a vehicle of transportation for some days or weeks longer.

Family MIMETIDÆ.

A small family, having two or three representatives in eastern and southern United States. The genus *Mimetus* is said to make one or two oblong cocoons, tapering equally at both ends, which are suspended by many threads connected with a web like that of *Theridion*, in the family Theridiidæ. The mother spider has been observed to watch over these cocoons. The cocoon of our other genus, *Ero*, is characterized in the type description below.

TYPE: **Ero furcata.**

The cocoon of this small spider has been described in detail by the English writer, Blackwall. In the fall months I found a number of cocoons about Ithaca, N. Y., that answered perfectly to the description, and I have, therefore, attributed them to this species. All were empty when found. They are little balloon-shaped affairs, resembling the cocoons of *Theridiosoma gemmosum*. Like the latter, also, they are suspended by a slender pedicle consisting of a bundle of stiff threads about a half-inch long. They are usually attached to the under side of a rock that does not lie flat upon the ground. The cocoon proper is one-eighth of an inch in diameter and composed of silk having a texture about like that of soft paper. It is pale brown in color. Around this is an irregular network made up of large meshes of reddish-brown threads. Some of these threads unite at the top of the cocoon to form the pedicle referred to above. When the young have emerged from the paper-like inner cocoon it is apparently an easy matter to escape through the large open meshes of the outer network.

The eggs are said to be large for the size of the spider, five to twelve in number, of a brown color, and not agglutinate.

Family ŒCOBIIDÆ.

Of this family, the genus *Œcobius* only is accredited to the United States by Simon. Relative to the subject in hand, he says: "Their cocoons are flocculent, slightly transparent, plano-convex, and fixed in place. They contain each seven or eight eggs, which are not agglutinate."

Family OONOPIDÆ.

On the authority of Nathan Banks, this family is given a representative—*Orchestina*—in our spider fauna. The cocoons are, in general, of a similar type, each consisting of a roundish bit of white floss covering a small number of eggs—only two in *Oonops pulcher*. There may be several cocoons, however, for each spider.

Family OXYOPIDÆ.

This family is best known by the genus *Pucetia*, from the Southern states and California. Its two representative species, *P. aurora* and *P. viridans*, suspend their cocoons in a little irregular web stretched for that purpose among leaves and branches. The cocoon is conical, and has little, rough, diverging points, which serve for attachment to the suspending threads. It has no flossy packing, and is made up of a single piece; that is, it has no suture. Hentz speaks of *P. viridans* as watching over her cocoon constantly. In the genus *Oxyopes* the cocoon differs much from that of *Pucetia*. It is discoid, very flat, and firmly attached, like that of *Philodromus*, in the family Thomisidæ.

Family PHOLCIDÆ.

The Long-legged cellar spider, *Pholcus phalangiodes*, is our most common representative. Members of the family in general make no containing sack for the eggs that could properly be called a cocoon. The eggs are simply held together in the form of a small, rounded mass by a few threads of silk. This little ball of animate possibilities is carried about by the female in her cheliceræ and pedipalps until the young are hatched and ready to disperse. The number of eggs is never very large, usually not more than five or six. A foreign species described by Simon carries only two eggs, which, however, are of unusual size. In other foreign species the eggs are brightly colored in shades of violet, brown, and green.

TYPE: **Pholcus phalangiodes.**

This spider may be found in cellars, hanging back downward from the threads of its irregular web. Two females carrying cocoons were taken in a cellar used for storing bananas, September 16. Hentz reports them as cocooning earlier, giving several dates in July when he observed them with their egg-balls. The latter consist of a rounded agglomeration of perhaps fifteen whitish eggs, held together by a few threads, but having no external covering other than such of these threads as extend from the outer surface of one egg to another. The whole mass is about three-eighths of an inch in diameter, and resembles in shape a small blackberry. It is held in front of the female by means of her cheliceræ and pedipalps. She continues to carry about the little cluster of spiderlings for some days after they hatch. The period of incubation is a little less than two weeks.

Family PISAURIDÆ.

Of the Pisauridæ, two genera, *Dolomedes* and *Pisaura*, are more or less common in the United States. They are wandering spiders, living along streams. One genus of the family, from foreign parts, spins a permanent web, but all the others make use of a web structure only when rearing their broods. All carry their cocoons about with them until the eggs are ready to hatch. Then they spin a silken shelter among leaves and branches, and, depositing their treasure there, guard it jealously and constantly. The young remain for some days or weeks in this shelter, living a sort of communal life. Apparently the mother never deserts them until they disperse to shift for themselves.

Species of the two common genera mentioned above carry their cocoon in the cheliceræ, holding it close to the sternum. Some other genera are more like the Lycosidæ in the manner of carrying the cocoon, for they have it attached to the spinnerets by a bundle of threads. In the first case—those that carry it in the cheliceræ—the cocoon is quite well rounded, and consists of a single piece of continuous tissue; in the second case it is more flattened, and is made up of two valves, one of which, the lower, is quite flat, the other very convex.

TYPE: **Dolomedes rufus.**

A very large, long-legged spider frequenting watercourses. In July and August the female deposits her eggs in a globular cocoon about the size of a common cherry. It is all of one piece and is probably whitish at first, but soon becomes discolored. The mother takes it up and carries it about in her cheliceræ until her instinct tells her that the eggs are about to hatch, when she prepares a nest for it. This is commonly made by drawing together a bunch of leaves, on bush or herb, with a web of silk. Such a retreat may be three or four inches in diameter. It bears some resemblance to the nest of a tent caterpillar, save that the web is not so dense. For two or three weeks the mother spider watches over this nursery, probably supplying the young with food. If one approaches quietly he always finds the spiderlings massed into a little ball, which, however, breaks up into scores of scurrying atoms at the least alarm. The mother's position is always on the outside of the nest, usually near the lower side.

Family SICARIIDÆ.

These Six-eyed spiders are not at all common in our country. Marx catalogues one species of *Scytodes* and two of *Loxosceles*. Cocooning habits in the two subfamilies, Sicariinæ and Scytodinæ, are in marked contrast. Members of the former group deposit their eggs under the arch of a stone, enclosing them in a thin cocoon of adherent material. This, in turn, they cover over with a layer of fine earth, free from trash and dirt, and so dry that it crumbles readily. The whole has the form of a depressed hemisphere. The Scytodinæ, on the other hand, all carry their cocoons in their cheliceræ, held close to the sternum. They are globular, and brownish or violet in color.

Family THERIDIIDÆ.

A large family of line-weavers, including among its species those that form the familiar cobwebs in buildings. The cocoons are usually round, flabby little balls, several of which are fashioned at intervals during the summer by the same spider. They are hung in the web occupied by the mother, or, in the case of some of the smaller Theridiidæ, placed in the hollow of a leaf whose edges have been drawn together. In these situations they may be further protected by bits of dried leaves, fragments of insects, or little tents of silk. Some species of the genus *Theridula*, departing from the general custom, make only one cocoon, which they carry about attached to their spinnerets. *Theridion carolinum*, a British species, is also said to have this habit. A common practice among some of the smaller species is to pick up a cocoon at the approach of danger, or when its location does not suit the mother, and carry it to some other place, there to deposit it or stand clasping it for hours. Some few also are said to clasp their cocoons at all times except when getting food. After the young have hatched they remain in the snare with the mother for some time. Blackwall states that during this period *Theridion lineatum* supplies its young with food.

TYPE: **Theridion tepidariorum.**

A common cobweb weaver in outbuildings and in recesses along the rock walls of gorges. At any time from midsummer until long after frost one may find their cocoons suspended in the top of their snares, while the female hangs back downward below them. The number of cocoons varies from two or three to as many as seven. Each one represents a separate brood, and an inspection of all the cocoons in a snare at any particular time will usually reveal some that are deserted, some that contain eggs, and some that are filled with newly hatched young. Such conditions prevail as late as the first days of November. In the warmer part of the season the cocoons have no protective covering of foreign material, but those observed after frost are usually covered with pieces of dead leaves that could not be disposed as found except by design of the mother spider. The cocoons are little, brownish, balloon-shaped objects, with rather weak, flabby walls. They vary a little in size, ranging from one-fifth to one-third of an inch in diameter. Each contains about 250 whitish eggs. These are not agglutinate, but adhere slightly to the loose interior lining of the cocoon. After the young have hatched they cluster around the outer surface of the cocoon for some time.

TYPE: **Theridium lineatum.**

This is one of the species that places its cocoon on the lower side of a leaf, the edges of which are drawn in by silken lines. Under the additional protection of a slight network of white silk, the mother stations herself here to keep watch over her treasure, which, at the approach of danger, she clasps with her palps and fore legs. The cocoon is perfectly round, about one-fourth inch in diameter, of loose texture, and bluish green or grayish in color. It contains from 100 to 160 yellowish-white eggs, not agglutinate. After the young hatch they remain in the nursery with the mother for a long time, and, according to Blackwall, are supplied by her with food.

Family THOMISIDÆ.

The Crab spiders make no web. They lurk in green foliage or flowers during the summer, and in winter species that survive find shelter under the bark of dead trees or under stones and leaves. The cocoons are usually lens-shaped and attached by one side, though sometimes they are free or suspended, like a hammock, in a shelter of leaves. There may be two valves united at the border, which presents, in this case, a little circular fringe. In some cases the cocoon is attached by a few threads within one or more leaves drawn together. Again it can be found in the tops of dead grasses or in flower clusters. Still other chosen sites among some species are the trunk of a tree, the angle of forked twigs, or the arch of a stone. The tissue of the cocoon is sometimes compact, sometimes of a flossy nature and adhering to the touch. It is unlikely that any species makes more than one cocoon in a season. The mother spider is observed to quit her wandering habits and become more sedentary when rearing her brood. In some cases she watches over her eggs and progeny, but several of our common species wander off as soon as the cocoon is finished.

TYPE: **Philodromus vulgaris.**

The cocoon is spun in the fork of a twig, or occasionally in a slight depression on the trunk of a tree or the surface of a stone. The outer covering consists of very stiff, tightly stretched, milk-white silk, getting thinner toward the edges. This encloses the angle between the twig and the branch, curving downwards a little on its upper border. Under this, and not in contact with it, is another similarly stretched fold of less compact silk covering fifteen to twenty reddish eggs. Under the eggs, next to the bark of the twig, is a light carpet of filmy silk. The eggs are not agglutinate, but are entangled somewhat by light threads.

The cocooning season occupies the latter part of September and most of October. The young hatch in a few weeks, but remain in the shelter of the cocoon until spring. The mother spider is never found about the cocoon unless she has not yet given the finishing touches to it.

TYPE: **Xysticus modestus.**

This is a small and not very common species, of sombre hues. The female attaches her plano-convex cocoon lightly to the under side of a stone and stays by it to afford it what material protection she can. It is about a quarter of an inch in diameter and consists of two valves, one of which is flat and attached to the stone; the other convex, forming a cap to the first piece. A narrow border of the former projects beyond the latter. The material of the envelope is thin but firm, and paper-like. It is white in color. The eggs, about twenty-five in number, are not agglutinate. In several instances that came under my observation in June the mother spider was found clasping a cocoon which contained newly hatched young.

Family ULOBORIDÆ.

We have three genera, including five species, of this family in temperate North America. There are two types of cocoons—the oval, plano-convex cocoon of *Hyptiotes*, and the elongate-depressed-cylindrical form of the genus *Uloborus*. The former is attached by the flat face to the side of a twig; the latter is placed, with others of its kind, along one of the rays of the web, like a bead on a string. It is pointed at both ends, and has numerous little projecting tufts which serve for attachment to the threads that hold it in place. In all cases the cocoons are of paper-like tissue. Hentz, speaking of the female of *U. americanus* guarding her cocoon, says that nothing will induce her to leave it, and that if it be torn from its place she will proceed to fasten it down again.

TYPE: **Hyptiotes cavatus.**

This is the Triangle spider, whose interesting snare and peculiar method of manipulating the same were first described by Prof. B. G. Wilder. Nothing was known of its cocooning habits, however, until the series of observations recorded in this paper was begun. Two female spiders, imprisoned in glass tubes the first week in September, furnished the key to the situation by spinning a cocoon each on the cork stopper. After that, by careful search, any number could be found in the field, though nearly all noticed for a week or so were old cocoons of the previous season. They are usually located on the dead branches of pine, just below a bud, where, by reason of their protective coloration, they are not easily seen. They are small, plano-convex objects, elongate oval in outline, and resembling somewhat certain scale-insects. The average length is from five-sixteenths to three-eighths of an inch, and the width a little over one-eighth of an inch. In texture they are paper-like; in color they differ scarcely at all from the dull gray and brown of the twig. Their most distinctive feature, noticeable only on close inspection, is the presence of fine cross-striations, due to very many parallel lines of silk loops or points, darker in color than the background, and standing up like the pile on velvet. The flat side of the cocoon applied to the twig is white. Old cocoons have a weathered appearance, and show little trace of the striation mentioned above. Each has also, near the down-twig end, a small opening through which the young spiders escaped.

Quite a number of spiders in one locality made the mistake of attaching their cocoons to a red-painted foot-bridge across a small creek. In this situation their gray tints made them very conspicuous; in fact, noticeable at some distance.

Each cocoon contains from five to twelve pale buff eggs, which adhere slightly, although they cannot be called agglutinate. A few freshly spun cocoons were found during the first half of September, but it was not until some two or three weeks later that the majority of the females laid their eggs. Upon the advent of cold weather the eggs were still unhatched; so it is likely that they remain in that condition until spring.

Family ZODARIIDÆ.

Prof. E. Simon credits us with two genera of this family, but Doctor Marx does not catalogue any species in our fauna. Concerning the foreign genus *Zodarion*, Simon says: "They construct, under rocks, a little spherical case of threads, which holds together small bits of stone and foreign bodies; the female shuts herself up there to lay her eggs, which are not very numerous and are enveloped in a little sack of firm white tissue."

THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 3—October, 1905.
(Whole Series, Vol. XIII, No. 3.)

CONTENTS:

List of Spiders in the Entomological Collection of the Kansas State University, ... *Theo. H. Scheffer.*

PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 3. OCTOBER, 1905. WHOLE SERIES, VOL. XIII, NO. 3.

LIST OF SPIDERS IN THE ENTOMOLOGICAL COLLECTION OF THE KANSAS STATE UNIVERSITY.

BY THEO. H. SCHEFFER.

THE following brief list includes fifty-nine species of Kansas spiders, representing thirty-three genera and ten families. The material has accumulated incidentally in collecting insects, and offers, therefore, only fractional representation of the Araneida of Douglas county, where most of the specimens were taken.

FAMILY DICTYNIDÆ.

DICTYNA.

D. foliacea Hentz (*Theridion*). Douglas county, June.

FAMILY THERIDIIDÆ.

TEUTANA.

T. triangulosa Walck. Douglas county, June to September.

STEATODA.

S. borealis Hentz. Douglas county, April and July.

THERIDION.

T. tepidariorum Koch. Douglas county, June, July, and September.

LATRODECTUS.

L. mactans Fabr. Clark county, June.

FAMILY ARGIOPIDÆ.

ARGIOPE.

A. trifasciata Forsk. Douglas county, September and October; Ford county, July (young).

ARANEUS.

A. benjamini Walck. (*Epeira*). Douglas county, August and September.
A. conspicellatus Walck. (*Epeira*). Douglas county, October.
A. insularias Hentz. Douglas county, October.
A. pegnia Walck. Douglas county, July.
A. strix Hentz. Douglas county, July.
A. frondosus Walck. (*Epeira*). Douglas county, September.

Araneus.

A. stellatus Walck. (*Plectana*). Douglas county, September to November.

A. trivittatus Keys. Douglas county, June to September; Clark county, June.

A. gibberosus Hentz (*Epeira*). Douglas county, July, August, and September.

A. arenatus Walck. (*Epeira*). Douglas county, August.

A. ocellatus Clerck. Douglas county, August.

A. pratensis Héntz (*Epeira*). Ford county, July.

Argyroepeira.

A. hortorum Hentz. Douglas county, June to August.

Micrathena.

M. gracilis Walck. (*Plectana*). Douglas county, July; Garnett, September.

M. reduviana Walck. (*Plectana*). Douglas county, August; Garnett, September.

M. sagittata Walck. (*Plectana*). Douglas county, June.

Cyclosa.

C. conica Pallas. Douglas county, July.

Tetragnatha.

T. extensa Linn. (*Aranea*). Douglas county, March to July; Clark county, June.

Family THOMISIDÆ.

Xysticus.

X. triguttatus Keys. Douglas county, July.

X. nervosus Banks. Douglas county, April.

X. gulosus Keys. Douglas county, September; Rossville, October.

Misumena.

M. asperata Hentz (*Thomisus*). Douglas, Clark and Ford counties, May to July; also, Douglas county, September.

M aleatoria Hentz (*Thomisus*). Douglas county, July and August.

Tibellus.

T. oblongus Walck. Douglas county, October.

Philodromus.

P. vulgaris Hentz. Douglas county, June.

Synema.

S. parvula Hentz. Douglas county, June.

Thanatus

T. rubicundus Keys. Douglas county, July.

Family CLUBIONIDÆ.

Anyphæna.

A. rubra Emerton. Douglas county, September.

A. gracilis Hentz (*Clubiona*). Douglas county, July.

Micaria.

M. aurata Hentz (*Herpyllus*). Clark county, June.

Trachelas.

T. tranquilla Hentz. Douglas county, September.

Family AGELENIDÆ.

Agelena.

A. nævia Walck. Douglas county, August to October.

Coras.

C. medicinalis Hentz (*Tegenaria*). Douglas county, March.

Family PISAURIDÆ.

Pisaurina.

P. mira Walck. (*Dolomedes*). Douglas county, August (young) and September.

Family LYCOSIDÆ.

Lycosa.

L. kochii Keys. (*Tarentula*). Douglas county, March.

L. communis Emerton. Douglas county, July; Clark county, June.

L. nidicola Emerton. Douglas county, May to July and October; Chase county, September.

L. scutulata Hentz. Douglas county, May (young); Clark county, June (young).

L. cinerea Fabr. (*Araneus*). Douglas county, July.

Pardosa.

P. lapidicina Emerton. Douglas county, July.

P. nigropalpis Emerton. Douglas county, June.

P. albopatella Emerton. Douglas county, May.

Family OXYOPIDÆ.

Oxyopes

O. salticus Hentz. Douglas county, July; Ford county, July.

Family SALTICIDÆ.

Phidippus.

P. morsitans Walck. (*Attus*). Douglas county, June to September.

P. rufus Hentz. Clark county, June.

P. tripunctatus Hentz (*Attus*). Douglas county, July and October.

Marptusa.

M. familiaris Hentz (*Attus*). Douglas county, May and September.

Hyctia.

H. pikei Peckham. Douglas county, October.

Dendryphantes.

D. capitatus Hentz (*Attus*). Douglas county, June.

Thiodina.

T. puerpera Hentz (*Attus*). Douglas county, June.

Pellenes.

P. elegans Peckham. Clark county, June.

Saitis.

S. pulex Hentz (*Attus*). Douglas county, July.

Phidippus.

P. militaris Hentz (*Attus*). Douglas county, July.

Summary of Species.

Dictynidæ	1	Pisauridæ	1
Theridiidæ	4	Lycosidæ	8
Argiopidæ	19	Oxyopidæ	1
Thomisidæ	9	Salticidæ	10
Clubionidæ	4	**Total number of species**	59
Agelenidæ	2		

THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 4—October, 1905.
(Whole Series, Vol. XIII, No. 4.)

CONTENTS:

Preliminary Report on the Experimental Septic Tank at the University of Kansas, ... *John S. Worley.*

PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 4. OCTOBER, 1905. { WHOLE SERIES, VOL. XIII, No. 4.

PRELIMINARY REPORT OF THE EXPERIMENTAL SEPTIC TANK AT THE UNIVERSITY OF KANSAS.*

BY JOHN S. WORLEY.

With plates XXIX to XL.

IN connection with the study of problems in sanitary engineering related to the rapid, efficient and economical disposal of sewage, a septic-tank system was installed south of the Fowler Shops, at the University of Kansas, and some analyses have been made of the effluent at various points in the system. The tank was built in the winter of 1903–'04, with the cooperation and under the supervision of Prof. W. C. Hoad, of the engineering department. The analyses of the effluent were made in the water-analysis laboratory. It is to be regretted that the series of analyses does not cover a longer period, but the end of the college year made it necessary to suspend operations. It is expected that the work will be continued by other students in the department.

The objects of the experiments were to study the workings of a septic tank, to note the effect of aeration on the effluent from the tank, and to see if, after thorough aeration, a second bacterial action could be secured in a second tank. A record was made of the approximate composition of the sewage treated, and the samples of effluent were taken at such points in the system as would show the efficiency at the stages mentioned.

The main tank was situated at the mouth of the sewer leading from the Fowler Shops. It was built of brick laid in Iola Portland cement and plastered with the same. Its inside measurements were 2 feet 6 inches wide, 3 feet deep, and 10 feet long, and it had a capacity of 68 cubic feet. The sewage entered the upper end through a tile which dipped under the surface; the effluent passed out over a two-foot weir at the opposite end. Just in front of the weir was a baffle board which extended to a depth of a foot below the surface, that the effluent be not drawn from the surface. After passing over the weir the water fell into a division box provided with an overflow and a small gate for regulating the amount to be aerated.

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*Abstract from a thesis presented to the faculty of the Graduate School of the University of Kansas for the degree of Master of Science; written under direction of Prof. Edward Bartow.

That part of the effluent used for aeration was led through 40 feet of 4-inch troughing to aeration boxes. These troughs contained seven cross-weirs, over which the water passed in thin sheets, thus coming in contact with air. After leaving the trough the water passed through a series of boxes, one placed above the other. These boxes were 1 foot 6 inches long, 8 inches wide, and 3 inches deep; each was provided with a weir 1 foot long, so that the water on leaving the box passed over this weir in a thin sheet, then dropped to the next box in single drops.

After leaving the aeration boxes the water was led by a short trough into the second tank, of the dimensions 1 foot 9 inches wide, 1 foot 6 inches deep, and 4 feet long, of the same construction as the large tank, and with a capacity of 10½ cubic feet. Both tanks had board covers, to keep out the direct sunlight.

The plan of the system is shown in plate XXIX and the elevation in plate XXX.

The sewage used was that from the two closets, the two urinals and the wash-room of Fowler Shops. The time of passage from the shops to the first tank was less than two minutes; so the solid material had no chance to go into solution or disintegrate. Owing to the solid matter having to pass directly into the tank, no analysis could be made of the sewage before its entrance. An automatic register was attached to the closets (see table I), and an account was kept of the amount of soap and sawdust used in the wash-room (see table II and plate XXXI). Owing to lack of time, no record was obtained of the number of times the urinals were used each day.

Samples of the effluent were collected in three places—as the water left the first septic tank, as it left the last aeration box, and as it left the small tank—the samples from these places

TABLE No. I.—Number of times closets were used each day.

DATE.	Times used.	DATE.	Times used.
April 12	10	May 2	22
“ 13	23	“ 3	15
“ 14	20	“ 4	19
“ 15	7	“ 5	31
“ 16	20	“ 6	31
“ 17	26	“ 7	24
“ 18	30	“ 9	15
“ 19	33	“ 10	25
“ 20	22	“ 11	25
“ 21	22	“ 12	25
“ 22	24	“ 13	23
“ 23	24	“ 14	25
“ 24	21	“ 16	30
“ 26	22	“ 17	45
“ 27	25	“ 18	35
“ 28	32	“ 19	35
“ 29	31		
“ 30	35		

TABLE No. II.—Amount of lye, soap, and sawdust.

DATE.		Amount used, in grams.					
		H. H. soap.		Lye soap.		Sawdust.	
From—	To—	Per day.	Per week.	Per day.	Per week.	Per day.	Per week.
March 14	Mar. 21	195	1.370	770	5,400	110	760
“ 21	“ 23	250	1.500	857	5,950	250	1,300
“ 28	April 4	250	1,500	1,085	6,510	248	1,485
April 4	“ 11	173	1,040	833	5,005	193	1,160
“ 11	“ 18	180	1,080	871	5.270	170	1,000
“ 18	“ 25	241	1,448	795	4,770	215	1,300
“ 25	May 2	262	1,572	510	3,060	178	1,070
May 2	“ 9	228	1,785	360	2,150	228	1,360
“ 9	“ 16	176	954	256	1,540	230	1.400
“ 16	“ 23	250	1,500	883	5,300	200	1.200

being designated as I, II, and III, respectively. Collections were made on Mondays, at twelve noon and five P. M.; on Wednesdays and Fridays, at eight A. M., twelve noon, and five P. M. Each sample contained one liter, which was taken directly to the laboratory and divided into two parts. That part to be used in determining the ammonias and the oxygen consumed was sterilized with 4 c. c. of a solution of one part sulfuric acid and three parts water; that part from which the other determinations were to be made was sterilized with 4 c. c. of a solution of one part formaline and three parts water. This method of sterilization was found to be perfectly satisfactory. The corresponding parts of each sample taken during the day were placed in the bottle, and samples drawn from this bottle were called the average for that day. Analyses for the week were made on the following Saturday.

In the chemical analysis the usual methods were adopted, with one variation, that being in the determination of nitrogen as nitrates.

TOTAL SOLIDS.—Fifty c. c. of the sample were evaporated on the water-bath to dryness; allowed to remain for twenty minutes, in order to have it as dry as possible, at the temperature of the water-bath; the bottom of the dish wiped with a clean cloth; and the dish was allowed to cool in a desiccator for one-half of an hour, then weighed. Afterward the dish was heated to a low redness and weighed, to determine the loss on ignition.

HARDNESS.—This determination was made by diluting 25 c. c. with 100 c. c. of pure distilled water and using the common Clark method.

CHLORINE.—Fifty c. c. were titrated with a standard silver-nitrate solution, using potassium chromate as indicator.

OXYGEN CONSUMED.—One hundred c. c. were treated by the Kubel method.

FREE AMMONIA.—Five c. c. of the water were added to 500 c. c. of ammonia-free water, and placed in a distilling flask, from which 150 c. c. were distilled and nesslerized in the usual manner.

ALBUMINOID AMMONIA.—To the water remaining in the flask after the free ammonia had been determined were added 50 c. c. of alkaline permanganate solution, and the distillation and nesslerization carried on in the usual way.

NITROGEN AS NITRITES.—Five c. c. of the water were diluted to 50 c. c., acidified with one drop of hydrochloric acid, and 1 c. c. each of sulfanilic acid and napthlamine hydrochloride added.

NITROGEN AS NITRATES.—Fifty c. c. were evaporated to dryness in order to drive off the ammonia, diluted up to its original volume, and placed in a Nessler jar; to this were added four inches of aluminum wire and 2 c. c. of pure concentrated sodium hydroxide; then allowed to stand for twenty-four hours. One c. c. of this solution was then diluted to 50 c. c. with ammonia-free water, and nesslerized in the usual manner, to determine the ammonia, these determinations being reduced to nitrogen by multiplying by 0.82.

The sewage was turned into the plant on March 5, and analyses started April 18, extending to May 23. The following table shows the results of the analyses, and plates XXXII to XL show a comparison of the various results at the three points of collection:

TABLE III.—Chemical analyses. (Parts per million.)

Number.	Date of collection.	Total solids.	Loss on ignition.	Hardness.	Chlorine.	Oxygen consumed.	Ammonia.		Nitrogen as—	
							Free.	Albuminoid.	Nitrates.	Nitrites.
I, 1	....	910	270	160.0	124.0	17.9	....	....	....	....
II, 2	....	794	200	180.0	116.0	14.3	....	....	....	....
III, 3	....	740	160	180.0	110.0	10.0	....	....	....	....
I, 4	....	1104	428	150.0	152.0	31.1	....	....	....	....
II, 5	....	936	330	150.0	152.0	27.0	....	....	....	....
III, 6	....	920	330	250.0	138.0	20.2	....	....	....	....
I, 7	....	890	310	140.0	108.0	21.5	....	....	....	....
II, 8	....	930	250	190.0	122.0	18.5	....	....	....	....
III, 9	....	820	240	200.0	112.0	18.4	....	....	....	....
I, 10	May 2	4200	....	170.0	112.0	36.2	31.10	20.70	0.28	19.63
II, 11	" 2	3860	....	150.0	91.2	32.3	43.00	23.50	0.24	30.34
III, 12	" 2	4170	....	150.0	134.0	26.0	30.20	25.00	0.35	24.60
I, 13	May 4	4000	3100	90.0	134.0	32.2	84.50	17.30	0.32	49.20
II, 14	" 4	3660	2780	120.0	132.8	28.6	63.00	13.50	0.24	44.28
III, 15	" 4	3680	2780	200.0	132.8	28.0	1.80	42.20	0.10	65.60
I, 16	May 6	3940	3100	250.0	67.2	23.0	11.90	10.20	0.07	9.60
II, 17	" 6	3940	3080	250.0	60.0	9.9	16.70	8.60	0.28	13.94
III, 18	" 6	4590	3740	240.0	58.4	9.5	21.40	17.00	0.32	15.16
I, 19	May 9	1460	640	530.0	104.0	15.9	19.70	14.50	0.16	18.50
II, 20	" 9	800	400	549.6	100.0	16.0	23.50	12.70	0.24	19.68
III, 21	" 9	940	460	509.6	90.0	14.3	20.00	12.30	0.22	19.68
I, 22	May 11	860	360	479.6	98.0	14.1	20.80	8.80	0.12	22.55
II, 23	" 11	896	336	479.6	115.0	10.9	22.00	8.20	0.22	22.55
III, 24	" 11	880	296	479.6	92.0	9.2	23.00	8.20	0.20	22.55
I, 25	May 13	2080	1220	479.6	108.0	17.0	26.40	9.00	0.12	28.70
II, 26	" 13	2126	1280	479.6	104.0	14.5	32.50	9.20	0.22	31.16
III, 27	" 13	2080	1200	479.6	96.0	11.4	26.00	6.20	0.24	31.16
I, 28	May 16	960	368	440.0	84.0	13.5	9.80	19.10	0.11	6.56
II, 29	" 16	960	340	440.0	92.0	10.5	23.50	8.20	0.24	13.12
III, 30	" 16	900	340	448.0	76.0	9.2	15.20	6.90	0.24	7.38
I, 31	May 18	3430	1320	440.0	110.0	12.3	17.00	9.30	0.04	8.20
II, 32	" 18	920	280	440.0	108.0	10.3	11.00	21.50	0.22	13.12
III, 33	" 18	860	320	400.0	88.0	7.4	0.20	22.50	0.22	7.38
I, 34	May 20	1944	1040	400.0	102.0	15.5	19.20	11.20	0.19	11.38
II, 35	" 20	2020	1190	360.0	102.0	12.5	19.40	7.40	0.17	11.38
III, 36	" 20	2132	1312	360.0	118.0	9.8	21.80	6.50	0.12	13.12
I, 37	May 23	840	380	320.0	106.0	16.9	0.40	28.20	0.18	13.12
II, 38	" 23	850	370	320.0	114.0	15.5	32.90	10.80	0.90	24.60
III, 39	" 23	750	340	260.0	100.0	13.0	22.00	9.80	0.90	14.35
I, 40	May 25	4380	3500	320.0	114.0	19.1	10.90	10.60	0.05	16.40
II, 41	" 25	3872	3072	400.0	114.0	15.1	0.20	33.40	0.04	14.35
III, 42	" 25	4250	3506	360.0	100.0	14.3	0.20	35.60	0.04	12.30

In this short time no definite conclusions can be drawn. However, the data obtained are suggestive of fields for investigation, and attention is called to the following things, as shown by table III:

The plant has not yet reached its maximum efficiency.

Aeration in itself is of value in bringing about purification.

Some purification is taking place in the second tank, but it requires more time before any conclusion can be drawn as to the changes which are brought about.

In the analysis the amount of dilution is such as to give opportunity for error in the methods described by Phelps (Journal of Infectious Diseases I, 327–340) for ammonia determinations.

From May 9 to 16, the average amount of soap, lye, sawdust, and toilet-paper—non-nitrogenous matter—was 625 grams; the amount of human excrement—nitrogenous matter—was 800 grams; from the 16th to the 23d, the amount of soap, etc., was 1500 grams, the human excrement remaining the same; however there is nothing in the analysis indicative of what became of the excessive amount of non-nitrogenous organic matter entering the tank.

After the plant had been in operation for some time the hardness of the effluents increased to about twice that of the city water used in the toilet-room. This is just opposite to what was expected, and at present cannot be accounted for. The hardness of the city water was determined by the same soap solution as was used in that determination of the sewage effluents.

The average amount of non-nitrogenous matter entering the plant is higher than the nitrogenous organic matter.

THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. III, No. 5—October, 1905.
(Whole Series, Vol. XIII, No. 5.)

CONTENTS:

On the Dorsal Glands as Characters of Constant Specific Value in the Coccid Genus Parlatoria, ... *Miriam A. Palmer.*

PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 5. OCTOBER, 1905. { WHOLE SERIES, VOL. XIII, NO. 5.

ON THE DORSAL GLANDS AS CHARACTERS OF CONSTANT SPECIFIC VALUE IN THE COCCID GENUS PARLATORIA.

BY MIRIAM A. PALMER.

With plates XXIII to XXVIII.

THERE has been much confusion as to classification of the different species of the genus *Parlatoria*. About nineteen species have been described, but the status of so many of these has been so uncertain that authorities have differed among one another, even the same authority being found to change his opinion from time to time.

Cockerell (1896, *c*, and 1899, *b*) and Mrs. Fernald (1903) give the genus as consisting of seventeen species, but do not agree exactly in their lists of species, and Marlatt, in his manuscript of March, 1900, tentatively declares the genus to consist of at most but six species. The cause of this confusion is the want of established constant specific characters on which to base a system of classification.

It is the purpose of this paper to give the result of investigations made upon the pygidia of the females of a number of the species of this genus for the purpose of ascertaining constant specific characters. The species or so-called species studied are *aonidiformis* Green, *blanchardi* Targ., *cingala* Green, *mytilaspiformis* Green, *proteus* Curt., *pergandei* Comst., *crotonis* Ckll., *theæ* Ckll., and variety *euonymi* Ckll., *victrix* Ckll., *viridis* Full., *theæ viridis* Ckll., and *zizyphus* Lucas, these being all that have been available. All the literature at hand on these species has been carefully consulted and compared in making conclusions.

For studying the characters herein discussed great care must be given to the technique. For this study the method used was as follows: The insects removed from under the scale were bleached in a strong solution of caustic potash, either by boiling till sufficiently bleached, or by leaving them in the solution from twelve to twenty-four hours. Great care must be exercised that the bleaching process may be carried just far enough to show all the necessary characters in the pygidium, but not so far that the insect becomes quite transparent, or there will be great danger of losing it during the process of transferring from one solution to another. The mouth-parts retain color longest, and often when the rest of the body is invisible to the naked eye the presence of the insect can be detected by the mouth-parts. After bleaching, the insects were washed twice in distilled water, being left each time for about ten minutes, then transferred to fifty per cent. alcohol for about fifteen minutes, then to ninety-five per cent. alcohol for about the same length of time. Since these insects are very difficult to transfer from one liquid to another without danger of maceration and great loss of time and energy, it was found best after removing them from the caustic potash to leave them in the same vessel, changing the liquid by means of a pipette. They were next transferred into a drop of clearing mixture* on a slide and left thus for fifteen minutes or longer, then a drop of xylol-balsam was added and the mount completed.

The materials used for this study were furnished by Professor Hunter, the head of the department, and the writer wishes to thank him for his direction and kindly assistance, to which this paper is largely due. The illustrations were all made by the writer with the use of the camera lucida.

PARLATORIA Targ.

DESCRIPTION OF GENUS.

The following description of the genus *Parlatoria* is given as gathered from the descriptions of Signoret (1868), Comstock (1881), Newstead (1901), and Green (1899), together with personal observations.

Scale of Female.—The female scale may vary from circular to elongate, and consists of two exuviæ with more or less of secretionary area around the sides.

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*This clearing mixture was composed of two parts, by measure, of carbolic-acid crystals and three parts of rectified oil of turpentine.

SCALE OF MALE.—The male scale is long, narrow, and non-carinated, with the median portion depressed after escape of male. The exuviæ are at the cephalic end. The scale is usually much smaller than that of the female.

PYGIDIUM OF FEMALE.—The most prominent characteristics of the genus, found in the pygidium, are the conspicuous marginal gland pores, situated between the bases of the lobes and giving a granulated appearance to the pygidium, and the fringed plates or squames situated between the lobes. The circumgenital glands or spinnerets are usually in four groups, but sometimes there are a few glands present representing the missing median group as noted by Green (1899) and seen by myself in *theæ*. There are always three pairs of well-developed lobes and sometimes rudiments of the fourth and fifth pairs.

PARLATORIA ZIZYPHUS Lucas.

Plate XXIII, figures 1 and 2.

This species, being regarded as the type species of the genus *Parlatoria*, is described first. The most important generic and specific characteristics in the genus *Parlatoria* are found in the pygidium of the female, and since it is only with these characteristics that this paper pretends primarily to deal, there will hereafter be no attention paid in descriptions to any characteristics outside of the pygidium. The reason for this is the inconstancy of the characters outside of the pygidium, such as shape and color of scale and color of body. This can be plainly seen on examination and comparison of literature and will be brought out in the discussion of the synonymy of the species herein discussed.

There are four groups of spinnerets, also called circumgenital, grouped, abdominal or ventral glands. These groups are designated as the anterior lateral and posterior lateral pairs of groups. There are four pairs of lobes, the fourth lobe being fairly well developed. The first three pairs are trilobate in form; the fourth lobe is about one-third the width of the third lobe and tapers to a point. Its length is almost equal to that of the third lobe. Between the bases of the lobes are the marginal-gland orifices or semilunar pores, which resemble, on superficial examination, chitinized crescents, but on closer examination are seen to be rather elliptical-shaped openings. Directly cephalad of each marginal-gland orifice are found structures resembling small chitinized rods. These are, according to Berlese (1896), the chitinized disks of the marginal-gland orifices. These crescents alternate with the lobes until after the third lobe, when there are two before the fourth lobe. There are also found between the lobes thin, flat, transparent, fimbricated processes called plates or squames. They are the same length as the lobes and vary in number of incisions from three to four in those plates mesad of the third lobe and number as high as eight to twelve or even more in those laterad of the third lobe. These plates are situated two in each of the spaces between the lobes mesad of the second lobes, and three in the spaces between the second and third and the third and fourth lobes.

Scattered over the pygidium and more numerous towards the edges are found the spool-shaped dorsal glands. These seem at first glance to have no definite arrangement, but on more careful observation of a number of specimens certain of these glands are found to be constant in position. These are the median dorsal gland, found on the median line just cephalad of the median marginal-gland orifice, and a pair of glands situated one on each side of the pygidium on a line drawn from the anal opening to the third lobe, and situated at about from one- to two-thirds of the entire distance from the anal orifice. This pair of glands was found in no other species studied. The arrangement of the rest of the glands is less constant. The dorsal glands near the margin and laterad of the median gland are sometimes arranged in a row even with the median dorsal gland, there being one dorsal gland approximately above each marginal gland. (See Pl. XXIII, fig. 1.) In different specimens and even in the two sides of the same specimen the arrangement of the glands laterad of the median gland may vary considerably, some being found more cephalad and some more caudad than the median dorsal gland. The number has been found to be fairly constant. There is also sometimes a second pair of glands found half-way between the pair above mentioned and the second or third lobes.

This species has been found on *Zizyphus pinnachristi*, date-palm, and the following varieties of citrus: Orange, lemon, and mandarin. The habitat is Europe, Algeria, Hawaiian islands, Formosa, China, West Australia, and in the United States on imported fruit.

This description has been made from the study of ten mounted specimens from lemon, mandarin, and a citrus plant whose variety is not given, with descriptions by Signoret (1868), Berlese (1896), Newstead (1901) and Comstock (1883) at hand and used for reference.

PARLATORIA BLANCHARDI Targ.

Plate XXIV, figure 2.

This species has four groups of circumgenital glands. There are three pairs of well-developed lobes. The rudimentary fourth lobe is absent. The form of the lobes is not trilobate, as in *zizyphus*, but broadly rounded at the ends, without notches on either side. The marginal-gland orifices are of the same form as in *zizyphus*, but the chitinized disks are not visible. The plates have the same arrangements as those in *zizyphus*, but are narrower in shape. Those along the sides laterad of the third lobe are much longer and have fewer incisions than those in *zizyphus*. The median dorsal gland is present. Laterad of this median dorsal gland and cephalad of the second marginal-gland orifice is a group of three dorsal glands. Cephalad of the third marginal-gland orifice and the third lobe is another group of three or four dorsal glands. The chitinized disks are not distinctly visible, or are seen very close to the orifices, the glands being probably situated almost at right angles to the body wall, so that the chitinized disks are hidden below the orifices.

Food-plant is the date-palm. Habitat: Australia, Algeria, and the Sahara. Described from nine mounted specimens.

PARLATORIA VICTRIX Ckll.

Plate XXIV, figure 3.

Victrix agrees in every particular with *blanchardi*. The food-plant is also the same. They differ only in habitat as given, *victrix* being found in Arizona, and *blanchardi* in Algeria, Sahara, and Australia; but Marlatt, in his manuscript of 1900, says that Cockerell's *victrix* originally came from the same locality as *blanchardi*. *Victrix* has been determined as synonymous with *blanchardi* by Hunter in manuscript, and Marlatt in manuscript, and it is so given by Mrs. Fernald (1903).

Studied from thirty mounted specimens taken from material received from Cockerell.

PARLATORIA CINGALA Green.

Plate XXVIII, figure 2.

This species differs from *zizyphus* in the number and shape of the lobes. There are three pairs of well-developed lobes. There is no rudimentary fourth lobe, but in place of it is found a broadly spindle-shaped thickening, situated with its long axis coincident with the body line. The lobes are not notched or trilobate as in *zizyphus*, but entire in outline and of a shape peculiar to the species, as shown in the figure. The marginal-gland orifices appear in crescent form between the lobes till laterad of the third lobe, when they appear more of the oval type. The chitinized disks are distinctly visible with both forms of glands. The plates are found situated as in *zizyphus*, but they tend to have fewer incisions, varying from two or three to four mesad of the third lobe. There are no dorsal glands found in the region of the pygidium cephalad of the first and second pairs of lobes. There is a large gland found directly cephalad of the third lobe. The pore of this gland lies with its long diameter parallel to the median line instead of at right angles to it as the pores in *zizyphus*. Along the edge of the body laterad and cephalad of the third lobe the dorsal glands are numerous.

The food-plants are leaves of the *Flacourtia* and *Scologia*. The habitat is Ceylon.

Described from five mounted specimens taken from material received from E. E. Green, together with his (1899) original description and figure.

PARLATORIA AONIDIFORMIS Green.

Plate XXIV, figure 1.

This species has four groups of circumgenital glands as in *zizyphus*, though they are not shown in the figure because they were not observed, the only specimens available not being sufficiently well cleared to show them satisfactorily. There are three pairs of well-developed lobes, decreasing in size from the median line outwards. The rudimentary fourth lobe is more or less developed. The first three pairs of lobes have each two notches on the outer edge and one or two on the inner edge. The marginal gland pores are found as in *zizyphus*, except that there is only one between the third and fourth lobes, while in *zizyphus* there are two. The chitinized disks of the marginal glands are present though not very prominent. The plates are unusually narrow and long; the incisions are not deep, and average about three or four in number. There are no dorsal glands like those in *zizyphus* to be found in the pygidium, but there are, according to Green (1899), and indistinctly seen in specimens observed, minute circular glands arranged in a row cephalad of the second lobe.

Food-plants: *Northopegia colebrookiana.* Habitat: Ceylon.

Described from two mounted specimens from material received from Green, supplemented by reference to Green's (1899) original description and drawing.

PARLATORIA PROTEUS Curt.

Plate XXV, figure 2.

pergandei Comst. Plate XXV, figure 1.
crotonis Dougl. Plate XXVIII, figure 1.
mytilaspiformis Green. Plate XXVI, figures 1 and 2.
theæ Ckll. Plate XXVII, figure 1.
var. ? **euonymi** Ckll. Plate XXVII, figure 2.
var. ? **viridis** Ckll. Plate XXVII, figure 3.

Proteus has four groups of circumgenital glands. There are three pairs of well-developed lobes. The rudimentary fourth lobe is absent and in its place is found a plate. The lobes are trilobate in form. The marginal-gland orifices are as in *zizyphus*. The position of the dorsal glands, however, differs from that in *zizyphus*, there being no median dorsal gland. Neither is the pair of glands mentioned as characteristic in the description of *zizyphus* found in *proteus*. The glands are also fewer in number. There is a pair of glands cephalad of the first pair of lobes, a single gland cephalad of the third marginal gland or the third lobe; then come numerous glands whose arrangement seems to be less constant.

Food-plants: *Selenipedium*, *Macrozamia*, *Pinus insignis*, *Myrtus*, *Citrus*, *Camellia*, *Machillus*, apple, date-palm, and *Vanda*.

Habitat: Europe, Australia, Japan, China, Formosa, Hawaiian islands, Brazil, and Ceylon.

Described from ten mounted specimens from *Pinus* and orchid from Ceylon and Japan, with Comstock's (1883), Newstead's (1901) and Signoret's (1869) descriptions at hand for reference.

pergandei Comst. Plate XXV, figure 2.

Pergandei has four groups of circumgenital glands. There are three pairs of well-developed lobes, trilobate in form. The rudimentary fourth lobe is present but not nearly so well developed as in *zizyphus.* It is often only a pointed prominence of the body wall, bearing a spine. The rudimentary fifth lobe is also present and similar in form and degree of development to the fourth lobe. The marginal-gland orifices are situated as in *zizyphus* and the chitinized disks are present. The plates are similar in form and position to those in *zizyphus.* The dorsal glands are the same in nature and arrangement as those in *proteus.*

Food-plants: Orange, lemon, and japonica. Habitat: Mexico, Japan, Hawaiian islands, Algeria, Europe, and southern United States.

Described from eleven mounted specimens from material on orange from China, Florida, and Lawrence greenhouse, with the original description of Comstock (1881), and also Newstead's (1901) description at hand.

mytilaspiformis Green. Plate XXVI, figures 1 and 2.

Mytilaspiformis has four groups of spinnerets or circumgenital glands. There are three pairs of well-developed lobes, trilobate in form. The rudimentary fourth and fifth lobes are very variable, being found present in some specimens and absent in others, even being present sometimes on one side and absent on the other in the same individual. The marginal glands and plates are found the same in form and position as in *zizyphus* and in *proteus.* The form and arrangement of the dorsal glands are the same as in *proteus.*

Food-plants: *Psychotria thwaitesii* and tea plant. Habitat: Ceylon.

Described from four mounted specimens from material received from Green, together with his (1899) original description and figure.

theæ Ckll. Plate XXVII, figure 1.

Theæ has the four groups of circumgenital glands found in *zizyphus*, but in addition there are one or two glands representing the missing median group. Cockerell (1896, *b*), in his description, says that there is but one median gland, but in one specimen observed two glands were seen, as shown by the figure. There are three pairs of well-developed lobes, decreasing in size from the median line outwards, and trilobate in form. The rudimentary fourth lobe is tolerably well developed and resembles that of *pergandei*. The marginal glands and plates are the same in form and position as in *proteus*, *pergandei*, and *zizyphus*. The dorsal glands are the same in character and arrangement as in *pergandei* and *proteus*.

Food-plant: Tea plant and Japanese maple. Habitat: Japan.

Described from four mounted specimens, together with Cockerell's (1896, *a* and, 1896, *b*) descriptions at hand.

theæ var. **euonymi** Ckll. Plate XXVII, figure 2.

This group differs from *theæ* only in having no representative of the median group of circumgenital glands, as ascertained from the study of four type specimens and reference to Cockerell's (1897) original description.

Food-plant: *Euonymous*. Habitat: Japan.

viridis Full., syn. **theæ viridis** Ckll. Plate XXVII, figure 3.

Viridis has five groups of circumgenital glands according to Cockerell (1896, *a*), the median group being represented by from one to four glands. In the specimens studied, however, it was impossible to determine whether the median group was present or not, the specimens not being sufficiently well cleared, and they are accordingly not shown in the figure. There are three pairs of well-developed lobes, decreasing in size from the median line outward. They are trilobate in form, and the tips are usually more produced beyond the plates than in *theæ*. The rudimentary fourth lobe is about the same in form and development as in *pergandei*. The marginal glands are the same in form and position as in *theæ* and *pergandei*. The plates are the same in position as those in *theæ*, but are generally not quite so long, allowing the lobes to project slightly beyond them, but this characteristic is rather variable. The dorsal glands have the same form and arrangement as those in *theæ*, *pergandei*, and *proteus*.

Food-plant: *Theæ viridis* has been found on *Ilex pedunculosa* in Japan, and *viridis* on *Pittosporum* in West Australia.

Described from three specimens of *viridis* and eight specimens of *theæ viridis*, four of which are type specimens, together with Cockerell's (1896, *a*, and 1896, *b*) original descriptions and drawings.

proteus var. crotonis Dougl. Plate XXVIII, figure 1.

Crotonis has four groups of circumgenital glands. There are three pairs of well-developed lobes, trilobate in form, and decreasing in size from the median line outwards. The presence of the rudimentary fourth lobe is very variable. The marginal glands, plates and dorsal glands are as in *proteus* and *pergandei*.

Food-plant: Croton. Habitat: Antigua, Jamaica, Great Britain, and in Massachusetts in botanical gardens.

Described from five mounted specimens, with descriptions by Newstead (1901), Cockerell (1892, and 1899, *a*).

DISCUSSION OF SYNONYMY.

The above so-called species described under *proteus* have been determined synonymous on the basis of the similarity of the arrangement of the dorsal glands. Although described as separate species, their validity has never been finally established. The distinguishing characteristics given by the various authorities have in every case proved inconstant or not of specific value, as will be brought out in the following discussion of the synonymy of these species with *proteus*.

Comstock (1883) differentiates *proteus* and *pergandei* on the basis of the shape of the scale of the female, given as circular in *pergandei* and elongated in *proteus*, but in 1881, in his original description of *pergandei*, he says that the scale of the female varies, being sometimes nearly circular but usually somewhat elongated. Hunter (1900 or 1904) says he finds no steadfast distinction either in shape or color of the female scale, finding circular scales among *proteus* and elongated scales among *pergandei*. Newstead (1901) says that the puparium of the female of *pergandei* is very variable, often being circular but sometimes elongate. It is accordingly evident that there has been no specific distinction found in the scale.

Comstock (1881), in a foot-note, mentions as a distinction between *proteus* and *pergandei* Signoret's description of the plates in *proteus* as being smooth on the mesal margin and serrate on the lateral, while those in *pergandei* are palmately incised, but this distinction has neither been observed by the writer nor found in any other descriptions or figures, and Comstock (1883) himself, in his later description and figure of *proteus*, shows the plates of *proteus* just the same as those of *pergandei*.

Newstead (1901) gives as a distinctive characteristic between these two groups the distinction of the rudimentary fourth lobe, present in *pergandei* and absent in *proteus*. This characteristic has been determined by the writer, on examination of a number of the so-called allied species, to be not of specific value, as will be brought out in the following discussion of the rest of the species above pronounced synonymous with *proteus*.

Authorities are also undecided on the question of the status of *pergandei*. Cockerell (1896, *c*) gives *pergandei* as a distinct species, and (in 1899, *b*) as a variety of *proteus;* and Marlatt, in his manuscript of 1900, says *pergandei*, which he makes a separate species, merges into *proteus*.

We will now investigate the status of *mytilaspiformis* as a valid species. Green (1899), in his original description, says that the species approaches very closely to *proteus*, but that it may be distinguished by the elongate form of the female scale and by the more prominent and elongate lobes of the pygidium. He also says that the pellicle or exuviæ of the male scale of *proteus* is said to be black. As to the shape of the scale, *proteus* is also often elongated, as discussed above, and examination of specimens of *mytilaspiformis*, on *Psychotria*, sent by Green, and *proteus* on orchid collected by Green, *proteus* on orange from China, sent by Craw, and *proteus* on *Pinus* from West Australia shows that there is much variety in the shape of the scale; in *mytilaspiformis* some being quite elongate while others are nearly circular, and in *proteus* they also vary from some as long as those in *mytilaspiformis* to nearly circular; so that no distinction in shape of scale can be observed. As to the more prominent and elongate lobes of the pygidium, no difference of any moment was detected by the writer either by observation of specimens or by comparison of descriptions or figures in any literature at hand. This cannot therefore be of specific value.

As to the color of the pellicle of the male scale, Signoret (1869) says that in *proteus* the male scale is light brown with the exuviæ blackish. Newstead (1901) says the exuviæ are pale yellow with dark green dorsum. Comstock (1883) says the exuviæ of the male are black. In *mytilaspiformis*, Green says that the pellicle is yellow with greenish center. According to these descriptions, the exuviæ of the male in *proteus* seem to vary from pale yellow with dark green dorsum to black, and there does not seem to be any sufficiently constant difference between the two groups to differentiate *mytilaspiformis* a valid species. Now there remains only the rudimentary-fourth-lobe characteristic which might be looked to for differentiation, but it is found to be inconstant, being present together with the rudimentary fifth lobe in some individuals and absent in others, and even being present on one side and absent on the other of the same individual. In some the place of the rudimentary fourth lobe is filled by a plate, as in *proteus*. No valid specific difference between *mytilaspiformis* and *proteus* seems to have been found, thus confirming the synonymy determined on the basis of the arrangement and character of the dorsal glands.

Theæ euonymi agrees in all observed characteristics with *theæ* except in the presence of the median ventral glands as mentioned above. Since it has never been named as anything but a variety of *theæ*, no discussion of it here is necessary.

Cockerell (1896, *b*, and 1896, *a*) describes *viridis*, making it a variety of *theæ*. Fuller (1897 and 1899) describes a distinct species which he names *viridis*. Neither of Fuller's descriptions is at hand, but specimens received from him were compared with type specimens of *theæ viridis* Ckll. and no differences were detected in any pygidial characters. Cockerell (1896, *b*), though he names *viridis* as a variety of *theæ*, says that he is not certain that it is not a valid species. A discussion of the value of the characters which he gives as distinguishing it from *theæ*, namely, the length of the median plates, which he says are shorter than the lobes, the bright green color of the body of the female, the five groups of ventral glands, the pale, flattened scale, would not be to the point here except so far as they might affect the relation of *viridis* to *proteus*. As to the length of the median plates, no difference can be observed between this group and *proteus*, this character being found variable in both. Nor does the color of the body seem to be a sufficiently constant character to distinguish it as a species. The body color in *proteus* is said by Newstead (1901) to be variable but usually purplish. Comstock (1881) says that in *pergandei* it varies from nearly white to purplish. Whatever difference there may be in the color of the body of the female in these two groups would not seem, therefore, to be of specific moment, though it might distinguish a variety. As to the five groups of ventral glands, there has not been opportunity in this study to investigate their constancy as a specific characteristic, but they do not seem to be considered to be of specific moment by Cockerell himself, for in 1897 he places *euonymi*, which has no median glands, as a variety of *theæ*, which has the median group represented. This cannot therefore distinguish it as a different species from *proteus*. Neither does the pale, flattened scale separate it from *proteus*, for in *proteus* pale, flattened scales were also found upon observation of specimens at hand. From study of pygidial characters no noticeable differences from *proteus* were found except the fourth lobe, which was the same as that in *pergandei*; but *pergandei* has already been determined to be synonymous with *proteus*.

The status of *crotonis* also is unsettled, and this affords another argument for the synonymy of *proteus* and *pergandei*, and the invalidity of the fourth-lobe characteristic, which is found to be quite variable in this group. *Crotonis* has been described by Douglas (1887) as a variety of *proteus*. Later Cockerell describes *crotonis* as a variety of *pergandei*, but (in 1899, *a*) he says that it appears to be the same as that described by Douglas, whose article on the subject he had overlooked. However, in 1902 he makes it a distinct species, on what basis is not known to the writer, the article not being available, but his previous changes of opinion would seem to indicate that he found no strong distinctive characteristics. The same unsettled state of opinion is seen in the case of Newstead. In 1900 he gives *crotonis* as a variety of *pergandei*, and in 1901 as a variety of *proteus*. From this it appears that *crotonis* has no distinctive character to differentiate it as a species, and that there is no constant character differentiating *proteus* and *pergandei.*

SUMMARY.

1. There have been no constant specific characteristics established in the coccid genus *Parlatoria* on which to base a system of classification. This is shown by the resulting confusion and difference of opinion as to the status of many described species.

2. The shape and color of the scale and color of the body of the female are so easily affected by change of environment, and on observation of specimens are found to vary so much in the same species, that it seems useless to look to these characters to find constant specific characteristics on which to base a system of classification.

3. The pygidium of the female being less exposed to external influences and being much used, it would seem that its characteristic structures would be most likely to persist. It has, therefore, been to this part of the body that the investigations of this study have been directed.

4. In the pygidium the dorsal glands have been found to possess a certain constancy in character and arrangement, differing in the different species, but remaining quite constant in the different individuals of the same species.

5. A comparison of the results obtained by my investigations with the opinions of the different authorities as extracted from the available literature shows that in every case where the distinction of the form and arrangement of the dorsal glands was found the status of the group as a valid species was unquestioned. On the other hand, where there was no distinction in these glands the authorities were found to differ among themselves, and the characters given as distinguishing the species have on investigation proved invalid. The classification made on this basis was found on comparison to agree exactly with Marlatt's synonymy, tentatively worked out and given in his manuscript of 1900, except that *pergandei*, which Marlatt makes a separate species, but says merges into *proteus*, is here made synonymous with *proteus*. On what basis Marlatt determined his synonymy is unknown to the writer of this paper.

6. Based upon the above-discussed characteristic of the form

and arrangement of the dorsal glands, the following classification or key to the species has been worked out:

A.—Dorsal glands absent or very minute and inconspicuous in the portion of the pygidium cephalad of the first and second pairs of lobes.
  B.—Large dorsal gland with longitudinal pore cephalad of the third lobe, the rudimentary fourth lobe replaced by a spindle-shaped thickening (see pl. XXVIII, fig. 2); lobes not notched or serrate .. ..*cingala.*
  BB.—No pronounced dorsal gland cephalad of the third lobe, the rudimentary fourth lobe present; lobes notched ....*aonidiformis.*

AA.—Dorsal glands present and easily seen in well cleared specimens in the portion of the pygidium cephalad of the first and second pairs of lobes.
  B.—Median dorsal gland present. (Pl. XXIII, fig. 1.)
    C.—Chitinous disks of marginal glands visible..............*zizyphus.*
    CC.—Chitinous disks of marginal glands not visible......*blanchardi.*
  BB.—Median dorsal gland absent...............................*proteus.*

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THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 6—October, 1905.
(Whole Series, Vol. XIII, No. 6.)

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PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 6. OCTOBER, 1905. { WHOLE SERIES, VOL. XIII, NO 6.

DIPTERA AFRICANA, I.

BY C. F. ADAMS.

IN my "Dipterological Contributions" (K. U. Science Bulletin, vol. II, No. 2, p. 21, 1903), I mentioned this material and described seven new species from it. I also promised at that time to give the whole collection some study and finally report thereon. It is now my pleasure to offer this paper as the first part of the work. The second part will be on the Muscidæ Calyptratæ,* which are now in my hands for study. This represents all of the material which is mounted, there being a large quantity still unmounted, mostly the minute forms. I hope to have the pleasure some time of working up this unmounted material and offering it as a third part of this series. I am fully aware of the difficulties met with and of the carefulness to be exercised in undertaking a work of this kind. It is no easy task to work successfully in one's own fauna, and therefore it is with some timidity that I offer this contribution on exotic material. But I have done my best to free it of errors, and if any are found herein, I beg kind indulgence or favor at the hands of my confreres.

As stated in the above-mentioned paper, this material was collected near Salisbury, Rhodesia, South Africa. The material, not only of the Diptera but of all the orders, shows that my friend Mr. Frank L. Snow is a diligent collector, and the Kansas University is fortunate in receiving the results of his trip to Africa. In due respect to his generosity, I name one of the species in his honor.

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*Since this was written conditions have changed. Some of the manuscript intended for the second part is included in this paper.

I take pleasure in acknowledging my indebtedness to Dr. F. H. Snow and to Dr. S. W. Williston. Without the favors received from these two friends the work would have been impossible.

TABANIDÆ.

HINEA, gen. nov.

Belongs to Pangoninæ. First and second joints of antennæ short, first twice as long as second; third joint with five annuli, first one longest and with a long basal process. Last joint of palpi very large and crescent-shaped. Proboscis straight, about as long as height of head. Face short, convex. Front depressed; its angle with occiput is smaller than in most Tabanidæ. Thorax and abdomen somewhat compressed. Wings considerably longer than the abdomen, first posterior cell open. Type, following species.

Hineia flavipes, n. sp.

Female: Black; front, antennæ, palpi, proboscis, except tip, legs, and tip of abdomen, yellow. Cheeks, occiput and pleuræ with sparse black pile; pile of legs short and yellow. The four hind coxæ are dark brown. Halteres black, knobs white. Wings black, a small hyaline spot in apex of first basal cell. Length, 16 mm.; of wing, 14 mm.

One specimen; December. This genus is dedicated to my friend Prof. Jas. S. Hine, who is doing so much for our knowledge of this family.

TABANUS.

(Linne, Fauna Suecica; 1761.)

Tabanus sagittarius.

Tabanus sagittarius Macq., Dipt. Exot., I, p. 123; Walker, List Dipt., pt. V, Suppl. 1, p. 228 (1850).

Tabanus socius Walker, l. c., pt. T, p. 160.

Tabanus serratus Loew, Dipteren-Fauna Südafrika's, 39, tab. 1, fig. 21.

Eight specimens; November and December. The above synonomy is from Miss G. Ricardo.

Tabanus latipes.

Tabanus latipes Macq., l. c. I, p. 119; Loew, l. c., p. 36.

Tabanus latipes Walker, l. c., pt. I, p. 236; pt. V, Suppl. I, p. 328 (1854).

Tabanus fenestratus Walker, Zoologist, VIII, app. 67 (1850); List, V, Suppl. 1, p. 219 (1854).

Tabanus africanus Grey.

Two specimens; December. The above synonomy after Miss Ricardo.

Tabanus tarsalis, n. sp.

Female: Eyes bare; first two joints of antennæ yellow, upper anterior angle of each, and the third joint wholly, black; face, cheeks, occiput and front thickly grayish pollinose, tubercle on lower part of latter reddish, reaches from eye to eye, and sends a slender projection upwards to middle of front, cheeks and lower part of face with long whitish pile; palpi very light yellow, almost white, bearing a few minute black bristles; proboscis black. Thorax reddish brown; mesonotum with three gray pollinose vittæ, remainder with a thin cast of gray dust, lateral margins, in front of wings, fringed with black pile, behind the wings with white pile; pleuræ with white pile; haltere brownish, knobs white. Abdomen dark brown, with three gray vittæ composed of subtriangular spots on each segment, those of lateral vittæ scarcely attaining the anterior margin of the segment; pile white; venter obscurely reddish brown, pile of last two segments black. Legs reddish yellow, tip of anterior tibiæ and all tarsi, except the base of the hind metatarsi, black; pile of femora and tibiæ white. Wings hyaline, base and costal margin to tip of first vein fuscous, veins at outer ends of basal cells and most of the longitudinal veins on basal half of wing bordered with brown; anterior branch of third vein without appendix. Length, 17–19 mm.

Four specimens; February.

ASILIDÆ.

NEOLAPARUS.

(Williston, Psyche, 255; 1885.)

Laparus pulchriventris.

Laparus pulchriventris Loew, Dipteren-Fauna Südafrika's, 58 (130); 1860.

One specimen; January.

LAXENECERA.

(Macquart, Dipt. Exot., I, 2, 77; 1838.)

Laxenecera albicincta.

Laxenecera albicincta Loew, Dipteren-Fauna Südafrica's, 122 (194); 1860.

Three specimens; January.

Laxenecera zonata.

Laxenecera zonata Loew, Dipteren-Fauna Südafrika's, 123 (195); 1860.

Three specimens; January.

Laxenecera sp.?

A small, poorly preserved specimen. It agrees fairly well with the description of *L. mollis* Loew, but its state of preservation does not admit of positive identification.

PROMACHUS.

(Loew, Linn. Ent. III, 390; 1848.)

Promachus æqualis.

Promachus æqualis Loew, Dipteren-Fauna Südafrika's, 127 (199); 1860.

One specimen; January.

Promachus flavibarbis, n. sp.

Female: Head yellow pollinose, in certain lights sides of face and posterior orbits silvery; front with yellow hairs on extreme lower part of sides and on vertex, sides with bristly-like hairs; face with only yellow bristles; palpi and proboscis black, pile of former yellowish, of latter white; cheeks with a fuscous tinge; occiput with white pile and with a row of black bristles on each side above; antennæ black, first two joints reddish and with short yellow pile. Mesonotum brown and with a median gray line, humeri and lateral margins yellowish pollinose, pile largely short and black, on anterior margin whitish, on posterior margin longer, and white and black intermixed, two rather strong presutural bristles, three postalar, one of which is rather weak, two supraalar, and three dorsocentrals on each side; scutellum yellowish pollinose, pile and bristles yellowish white, except a large black bristle on each side; pleuræ grayish pollinose, pile white, two white and two black bristles on upper margin of mesopleuræ; halteres yellow, tuft in front of them yellowish white. Abdomen yellowish pollinose, second, third, fourth and fifth segments with a large subquadrate, basal, black spot, pile yellowish, on first segment rather long and white, sixth and following segments nearly wholly shining black; venter grayish yellow, with white pile, each segment with a small, oval, reddish bare spot centrally. Coxæ grayish pollinose, front pair thickly, middle and hind pairs sparsely, white pilose, two hind pairs with a few strong yellowish bristles. Legs black, under side of femora, four anterior tibiæ, except their tip, hind tibiæ, except anterior surface, and upper surface of four anterior metatarsi reddish, pile white, bristles black, a few on under side of femora and on tarsi whitish. Wings hyaline, veins fuscous, first submarginal cell with a narrow gray streak. Length, 27 mm.

One specimen; October.

Promachus apicalis, n. sp.

Male and female: Head yellowish pollinose; bristles of sides of front black, the strongest ones of the mystax light yellow, remainder and those under antennæ black; palpi and proboscis shining black; sparsely light-colored pilose; pile of occiput white, a row of black bristles along posterior orbits; cheeks shining black; antennæ black, first two joints with short black hairs. Thorax grayish yellow pollinose, prothorax with a transverse row of black bristles; mesonotum with a median brownish line, which is bordered laterally by two broader, velvety-black vittæ, a large sublateral, velvety-black spot, divided by the suture, and a smaller, similarly colored one just laterad to dorsocentrals on posterior part; two presutural, two supra-alar, two postalar, and four dorsocentral bristles, pile very short, black, in the female a few white ones posteriorly; scutellum with an apical pair of black bristles, pile yellowish; pleuræ with sparse, very minute, yellowish pile, mesopleuræ without bristles above; halteres yellowish. Abdomen black, uniformly grayish yellow pollinose, pile short, yellowish, each segment with a pair of yellowish bristles on each side. Legs black, short pile yellowish, with about an equal number of black and whitish bristles. Wings with a light fuscous tinge, last submarginal cell, on an average, about as wide as the first, apex of of wings gray opaque. Length of male, 16 mm.; of female, 18 mm.

Three specimens; January.

Promachus solus, n. sp.

Female: Face largely yellow pollinose, silvery on sides, bristles of mystax yellowish white and black, long pile below antennæ white; front yellowish pollinose, bristly hairs black; antennæ black, first two joints with short yellowish pile; palpi and proboscis black, bristles of former white and black, pile of latter white; cheeks largely shining black; occiput gray pollinose, pile white, and with a row of black bristles on each side above. Mesonotum brown pollinose, with a median gray vitta, humeri reddish, region above humeri, lateral margins to just behind suture, and the borders of the median, golden yellow pollinose, hind part of mesonotum largely gray pollinose, two presutural, two supraalar and two postalar bristles present, two rows of bristly hairs replace the dorsocentrals on mesonotum; scutellum gray pollinose, bristles black, pile white; pleuræ grayish yellow pollinose anteriorly, gray posteriorly, pile white and black, mesopleuræ without bristles on upper part; halteres lemon yellow. Abdomen black, lateral and hind margins narrowly gray pollinose, and fringed with white pile, pile of darker portion of dorsum black, venter gray, with white pile. Coxæ gray pollinose, pile white, middle pair with a single black bristle, legs reddish yellow, pile white, a spot on under side of femora, knees, tips of tibiæ, tarsi and all bristles black. Wings hyaline, first submarginal cell with a slender gray streak. Length, 15 mm.

One specimen; June.

Promachus negligens, n. sp.

Male and female: Very similar to *P. flavibarbis* but is larger, and the general color of the pollen, except on the face, is gray; the antennæ are wholly black, the face is furnished with some black bristles; palpi of female with black and whitish bristles, of male yellowish white; occiput of female without black bristles above. Mesonotum reddish in ground color on shoulders and margins; scutellum with black bristles, pile white; mesopleuræ without bristles on upper part in the male, in the female with three strong and two weak black ones. Pile of black spots of abdomen black, three black bristles among pile on sides of first segment of male; hypopygium with a tuft of white pile above. Middle coxæ with several whitish bristles, hind coxæ and all legs with black bristles, pile white, of the male the anterior surface of the four front femora, apex of hind femora, tip of tibiæ, and tarsi wholly black, legs of female dull red, tips of femora, tibiæ and tarsi wholly black. Wings hyaline, first submarginal cell of female with a faint streak of gray. Length: Male, 26 mm.; female, 31 mm.

Three specimens; November and February.

SISYRNODYTES.

(Loew, Neue Beiträge, IV, 40; 1856.)

Sisyrnodytes major, n. sp.

Male and female: Black, shining, white and brownish pilose. Mesonotum and dorsum of abdomen finely punctulate. Bristly hairs of first two antennal joints white, base and tip of antennal style reddish yellow; pile of palpi black; pile of lower part of face, front and upper part of occiput yellowish white; ocellar tubercle with long, white, bristly hairs. Pile of thorax white and brown intermixed, a narrow median line on anterior part composed wholly of white pile, below and behind base of wings a large tuft of light brownish pile; halteres yellowish, knobs black. A tuft on sides of first abdominal segment, and pile of posterior and lateral margins of all segments white pilose; long sparse pile of venter white. Bases of all tibiæ reddish in ground color, pile of legs white; bristly hairs of femora, bristles of the four front tibiæ and basal half of hind tibiæ yellow, remaining bristles, or spines, black. Wings hyaline, all veins broadly bordered with brown, especially center of wing, anterior branch of fourth vein with a stump on anterior side near base, costal border fringed with short white hairs. Length of male, 10 mm.; female, 12 mm.

Three specimens; September.

BOMBYLIIDÆ.

BOMBYLIUS.

(Linne, Fauna Suecica; 1761.)

Bombylius analis.

Bombylius analis Fabr., Ent. Sust., IV, 408, 5.
Bombylius discoideus Fabr., l. c., IV, 409, 6.
Bombylius thoracicus Fabr., Syst. Antl., 130, 9.
Bombylius analis Wied., Zool. Mag., II, 42.

One female and four males, collected during February.

HYPERALONIA.

(Rondani, Archiv. Zool., III, 57; 1863.)

Hyperalonia vittata.

Hyperalonia vittata Ricardo, Ann. a, Mag. Nat. Hist., vol. 7, 7th Ser., No. 37, p. 104; 1901.

Three specimens; September.

SYSTROPUS.

(Wiedemann, Nova Dipt. Genera; 1820.)

Systropus snowi, n. sp.

Male and female: Antennæ black, basal four-fifths of first joint reddish; front and face lemon yellow, in certain lights silvery; proboscis black, palpi yellow, linear; cheeks and occiput black, grayish pollinose. Thorax black, whitish pile very short; mesonotum with the lateral margins reddish yellow; this color occupies the lateral third of anterior margin of mesonotum, then narrows considerably at a point midway between humeri and wings, widens at base of wings and reaches posterior margin; a spot above front coxæ lemon yellow; pleuræ reddish centrally; halteres reddish, knobs black on one side, lemon yellow on the other. Abdomen black, second, third, fourth and basal half of fifth segments, except a stripe on dorsum of each, reddish yellow. Legs reddish; front coxæ, except base and apex, last four joints of front and middle tarsi and hind tibiæ and tarsi, blackish; outer side of front and middle tibiæ and metatarsi lemon yellow, in certain lights silvery. Wings with a uniform fuscous tinge; two submarginal cells present. Length, 19–20 mm.

Twenty-three specimens; January. Dedicated to Mr. Frank L. Snow, son of Dr. F. H. Snow, in deference to his interest and energy in collecting insects while in Africa. Not only Diptera but all orders yielded bounteously to his net, and the collections of the Kansas University have been greatly enriched by the addition of this splendid material.

EMPIDÆ.

STILPON.

(Loew, Neue Beiträge, VI, 34 and 43; 1859.)

Stilpon obscuripes, n. sp.

Female: Black, in large part shining. Front gray, with parallel sides; vertex with two pairs of forwardly directed bristles; occiput grayish subshining; eyes emarginate opposite antennæ, and narrowly separated below, face receding; antennæ black, pubescent, second joint with a rather long bristle on under side at apex, third joint short, oval, arista subapical and about three times as long as the antennæ; mouth-parts black, proboscis much shorter than height of head, directed somewhat backward, palpi clavate, bearing a few yellow bristles. Mesonotum shining, bearing short yellow pile, and on posterior two-thirds longer black bristles, pleuræ partially covered with grayish pollen, scutellum with an apical pair of bristles and a smaller subapical bristle on either side; halteres yellow. Abdomen short, contracted, sparse pile yellowish white, ovipositor simple, compressed. Coxæ and legs largely shining black, tip of coxæ, extreme base and tip of femora, tibiæ except broadly in the middle, tarsi except last two joints, of a yellowish cast. Wings hyaline, anal cell wholly absent, first basal cell two-thirds as long as second, first vein joins costa slightly beyond a point opposite apex of second basal cell, third and fourth veins parallel, costa reaches tip of fourth vein. Length, 2 mm.

Two specimens; October.

ELAPHROPEZA.

(Macquart, Dipt. du Nord de France, I; 1827.)

Elaphropeza dispar, n. sp.

Male and female: Shining yellow. Eyes contiguous above and below antennæ, slightly emarginate opposite them; occiput and vertex black, former broad and with fine yellow pile, and a pair of rather strong bristles on top, latter with a forwardly inclined pair of yellow bristles just in front of the ocelli; first two joints of antennæ yellow, second joint with small yellow bristles at apex, third joint lanceolate-elongate, brownish black, arista terminal, about a third longer than the antennæ, sparsely pubescent; mouth-parts yellow, proboscis much shorter than height of head, palpi clavate, bearing a few short yellowish bristles. Thorax wholly yellow, sparsely yellow pilose, mesonotum with three yellowish bristles on sides posteriorly, and a pair dorsally just in front of the scutellum; scutellum yellow, with an apical pair of yellow bristles; halteres yellow. Abdomen yellow, third segment black, as long as first and second segments together, hypopygium yellow, with yellow pile, lamellæ large, median filament arcuate, mostly concealed. Legs yellow, extreme tip of femora, tibiæ, and last joint of tarsi brownish, pile yellow. Wings hyaline, veins brownish, anal cell wholly absent, second basal cell twice as long as the first, tip of first vein opposite apex of second basal cell, costa reaches tip of fourth vein. Length, 2 mm.

Four males and six females; April, May, and June.

PLATYPALPUS.

(Macquart, Dipt. du Nord de France, 94; 1827.)

Platypalpus univittatus.

Platypalpus univittatus Loew, Dipteren-Fauna Südafrika's, (341) 269.

One damaged specimen in the collection agrees partially with Loew's description. The last two joints of the antennæ and a part of the wings are gone, and its certain identification is impossible. The proboscis and a spot above the middle coxæ are black.

EMPIS.

(Linne, Fauna Suecica; 1763.)

Empis validis, n. sp.

Male: Black, subshining. Face bare, shining, occiput and cheeks thinly gray pollinose, eyes contiguous above antennæ, antennæ black, third joint tapering, style nearly half as long as third joint, proboscis shining black, twice as long as height of head. Thorax uniformly subshining, a sprinkling of gray pollen on pleuræ; bristles longest along sides of mesonotum, black; halteres yellowish at base, knobs brown. Abdomen a little more shining than the thorax, pile black; hypopygium small, concealed in the last ventral segment. Legs black, mostly shining; basal half of all tibiæ yellow; front and hind metatarsi somewhat incrassate, the intermediate ones of usual size; pile and bristles black, pulvilli yellow. Wings hyaline, veins light brown; in venation somewhat similar to the figure for *E. perpendicularis* Loew, differing by having the anterior branch of third vein straight, and forming with it a right angle, the discal cell is a little shorter, and the vein between the second and third posterior cells is nearer to the fourth vein. Length, 3.25 mm.

One specimen; April.

LONCHOPTERIDÆ.

LONCHOPTERA.

(Meigen, Illig. Mag., II, 272; 1803.)

Lonchoptera africana, n. sp.

Female: Head yellow; ocellar dot black; besides the ocellar and a pair of verticals there is a pair of backwardly curving bristles centrally on anterior part of front; antennæ yellow, first and second joints with a circle of black bristles apically, tip of third joint, with the arista, black; mouth-parts yellow, oral margin bearing several strong black bristles; a few bristles along posterior orbits white. Thorax reddish yellow; mesonotum with a median longitudinal black stripe, and the lateral margins likewise of the same color; two small humeral, one posthumeral, one notopleural and six dorsocentral bristles on each side; the latter are placed in two rows, with a single bristle placed between them; the inner row has three and the outer has two; scutellum with a median black line, and an apical pair of bristles; pleuræ and halteres yellow. Abdomen yellow, with a broad, dorsal, longitudinal band and the narrow lateral margins blackish. Legs yellow, the anterior tarsi wholly and the last joint of the remaining tarsi black. Wings hyaline, with a faint yellowish tinge; venation normal. Length, 3.2 mm.

One specimen; April. Close to *L. lutea* Panz., but differs principally in the coloration of antennæ and the lateral margins of the mesonotum and abdomen.

PHORIDÆ.

APHIOCHÆTA.

(Brues, Monograph of the North American Phoridæ, 337.)

Aphiochæta? n. sp.?

An imperfect female specimen which I believe belongs to this genus, and also to represent a new species, but the four posterior legs are gone; so I cannot speak with certainty for either case. The front is brownish black, subopaque, with only one pair of proclinate bristles on anterior part, otherwise its chætotaxy is normal; antennæ, face and mouth-parts are yellowish, arista pubescent. Thorax yellow, one posthumeral, three small bristles just in front of base of wing, and one dorsocentral on each side; scutellum with a single pair of bristles; halteres yellow. Abdomen reddish yellow, ovipositor black, subopaque.

The legs, so far as present, are light yellow. Wings hyaline, costa reaches almost to the middle of the wing, distinctly ciliated, third vein forked, tip of first vein ends at about two-thirds the distance between the humeral and tip of third vein, fifth and sixth veins divergent apically. Length, 1.2 mm.

April.

SYRPHIDÆ.

MELANOSTOMA.

(Schiner, Wiener Ent. Monatschr., IV, 213; 1860.)

Melanostoma bituberculata, n. sp.

Male and female: Head black, mostly shining; eyes, in male, with large facets above; front of female with cross band of gray pollen; face sparsely gray pollinose, with two small, but distinct, tubercles in center; cheeks and occiput grayish pollinose; halteres yellow. Abdomen brownish black; antennæ yellow, apex of third joint blackish above, arista yellow; mouth-parts brownish black. Thorax black, shining, pile short and light; sides of mesonotum and pleuræ lightly gray pollinose; first segment immaculate, second with an ovate yellow spot on each side, attaining the lateral margin at the anterior third of the segment, but not in contact with either anterior or posterior margins; third and fourth segments each with a pair of rather long spots which are broadly in contact with the anterior margin, and also with the lateral margin at the anterior angle; fifth segment with a pair of short but similarly colored spots; in one male specimen the spot is in contact with nearly the whole lateral margin. Legs, except base of coxæ and last two joints of hind tarsi, wholly yellow. Wings hyaline. Length, 7 mm.

Six specimens; May and June.

ERISTALIS.

(Latreille, Hist. Nat. des Crust. et des Ins., XIV, 363; 1804.)

Eristalis longicornis, n. sp.

Female: Vertex subshining black, black pilose; middle third of front yellowish pollinose, and yellowish and black pilose; lower third and antennal protuberance subshining black, sparsely black pilose. Eyes pilose above; with small black dots, most numerous and mostly fused on posterior half. Face black, grayish pollinose, light yellow pilose; median vitta broad, shining; a broad stripe from lower angle of eye to oral margin shining black. Cheeks largely shining black; light pilose. Occiput black, grayish pollinose and white pilose. Proboscis black, long as height of head. Antennæ black, third joint as long as first and second together, arista yellow, about as long as third joint. Thorax black, brownish pollinose, sparsely so back of suture, pile yellowish; scutellum yellow translucent, yellow pilose on base and margin, pile of dorsum black. Halteres yellow. First segment of abdomen black, yellow on sides, with grayish pollen; second segment yellow, narrowly bordered anteriorly with black, a broader band on hind margin slightly projecting forward in the middle; third segment yellow on basal half, subopaque black on apical half; fourth and fifth segments wholly subopaque black; venter yellow, second and third segments with a black spot on lateral margin, fourth and sixth segments wholly black. Femora shining black, tips of tibiæ, anterior tarsi, last four joints of middle tarsi, and last joint of hind tarsi fuscous. Wings hyaline. Length, 13 mm.

One specimen; February.

Eristalis æqualis, n. sp.

Female: Front black, grayish pollinose, largely black pilose, vertex subshining, a small tubercle above base of antennæ shining black; eyes sparsely pilose above, with four dark brown, vertical stripes, between which are small dark brown spots, most numerous on upper half of eye, in which region the facets are scarcely larger than on lower half of eye; face black, grayish pollinose, yellowish pilose, with three shining black vittæ; a broad stripe from lower corner of eye to oral margin, and cheeks largely, shining black; occiput subshining black, grayish pollinose; antennæ reddish yellow, upper margin and tip of arista black. Thorax brownish pollinose, dorsum with four shining black vittæ, each of which is bordered with a velvety-black line, pile yellowish; scutellum yellowish translucent, with yellow pile; halteres yellow. First segment of abdomen yellow, a central triangle and a small oval oblique spot on each side black; second segment yellow, a narrow black band on anterior margin, a large semicircular spot occupying the apical half, shining on posterior edge; third segment largely shining black, anterior border yellow; fourth segment black, an oval spot on each side opaque, just anterior to which is a convex transverse grayish sheen; fifth segment wholly shining black. Femora, except extreme tip, posterior tibiæ centrally, shining black; tips of tarsi fuscous; otherwise the legs are yellow. Wings hyaline, marginal cell closed in wing margin. Length, 10 mm.

One specimen; December.

Eristalis communis, n. sp.

Male: Eyes pilose above, with five vertical, blackish brown stripes, facets on upper half of eye larger than on lower; vertical triangle black, subshining, with black pile, frontal triangle black, subshining in the middle, yellowish gray pollinose on sides, pile of sides yellowish, of the middle black; face black, yellowish gray pollinose, a short median line over facial tubercle, and one on each side of face shining, pile yellowish; cheeks yellow, subshining, pile light yellow; occiput black, light gray pollinose, pile almost white; antennæ black, lower margin, and arista, yellowish, latter bare. Thorax brownish pollinose, with four bronze, subshining vittæ, pile yellowish; scutellum yellowish translucent, broadly on base and margins yellow pilose, black pilose centrally; halteres yellow; pleuræ subshining. First segment of abdomen yellow, grayish centrally; second segment yellow, the basal black border not very broad, attenuated laterally, apical black border likewise not very broad, scarcely attenuated laterally, shining on posterior edge, a light brown spot in center segment; third segment yellow, apical third blackish violaceous, largely shining and extending forward slightly in center; fourth segment wholly blackish violaceous, brownish pollinose and opaque basally; hypopygium shining blackish violaceous; venter yellow, second and third segments each with three brownish spots, fourth segment blackish. Femora and hind tibiæ shining metallic fuscous; tip of anterior tibiæ and last three joints of all tarsi fuscous, otherwise tibiæ and tarsi yellowish. Wings hyaline.

Female: Pile of front largely black. Apical half of third abdominal segment blackish violaceous, on basal half is a transverse, grayish pollinose band; fourth segment also with a similar band, both ends of which bend backward; venter of third segment wholly black; otherwise as in male. Length, 13 mm.

Three specimens; September.

Eristalis dissimilis, n. sp.

Male: Eyes contiguous above, brownish pilose, which is most prominent above, and with numerous small blackish spots; vertical triangle black pilose; front and face black, grayish pollinose and white pilose, facial tubercle and oral margin shining yellowish, sides of face on lower half nearly devoid of pollen; cheeks black, mostly shining; occiput yellowish-gray pollinose; proboscis shining black; antennæ yellow, upper margin brownish black, brownish arista bare. Thorax yellowish-gray pollinose; mesonotum with four bronze, subshining vittæ; pile light yellow; scutellum yellowish translucent, pile of base and margin light yellow, that of the dorsum black; halteres yellow; pleuræ largely subshining black. First abdominal segment gray pollinose, yellowish on sides, second segment yellow, with an opaque, black cross-band on base attenuated laterally, the apical cross-band is not attenuated laterally, is narrower and opaque black except centrally along posterior margin, where it is shining bronze, in most specimens the two bands are nearly connected centrally by a brownish longitudinal vitta; third segment yellow, posterior margin broadly subshining black, a brown spot centrally on anterior part; fourth segment shining black, anterior margin, except laterally, reddish yellow, back of this is a narrow, yellowish-gray pollinose, transverse band, sometimes interrupted in the middle; hypopygium shining black; pile of abdomen yellow, on dorsum of first segment, and lateral margins of remaining segments, white. Legs shining black, base of femora indistinctly, knees, basal two-thirds of the four anterior tibiæ, base of hind tibiæ narrowly, and the tarsi, except the third and fourth joints of the four anterior feet and last three joints of hind feet, yellow; pile of femora whitish, different parts of tibiæ and tarsi covered with pile of the same color. Wings hyaline, veins brownish, stigma small. Length, 10 mm.

Six specimens; September.

Eristalis analis.

Eristalis analis Macq., Dipt. Exot., II, pt. 2, p. 36; 1842.

Male and female specimens agreeing with the description of Macquart, but present the following additional characters: On the mesonotum between the wings there is a broad transverse area which is almost wholly devoid of pollen, causing a transverse vittate appearance. The fourth abdominal segment, in each sex, has three transverse pollinose bands; the two basal ones are gray, the apical one is yellowish gray.

Five specimens; December.

Eristalis (Megaspis) curtus.

E. (Megaspis) curtus Loew, Dipteren-Fauna Südafrika's, (391) 319; 1860.

Ten specimens of this beautiful species, collected during September and January. The facets of the upper half of the eye, in the male, are larger than those of the lower half.

Eristalis (Megaspis) capito.

E. (Megaspis) capito Loew, Dipteren-Fauna Südafrika's, (393) 321; 1860.

Ten specimens; January. Like the preceding species, the eyes of the male have large facets above.

SYRITTA.

(St. Fargeau et Serville, Encycl. Meth., X, 808; 1825.)

Syritta pipiens.

Musca pipiens Linne, Fauna Suecica, p. 1822; 1761.

One specimen; September.

RHINGIA.

(Scopoli, Entom., Carniolica, 358; 1763.)

Rhingia cœrulescens.

Rh. cœrulescens Loew, Dipteren-Fauna Südafrika's, 302 (374); 1860.

One specimen; January.

PIPUNCULIDÆ.

PIPUNCULUS.

(Latreille, Hist. Nat. des Crust. et des Ins., 1804.)

Pipunculus abdominalis.

Pipunculus abdominalis Loew, Ofv. K. Vet. Akad. Forhandl., xiv, 374, 3 (1857).

A male specimen, collected during May. Agrees well with Loew's description.

Pipunculus, n. sp.?

Female: Occiput, front and face opaque gray pollinose; first two joints of antennæ and arista black, third yellow, acuminate. Thorax opaque; mesonotum brownish pollinose, gray on humeri and sides, former yellowish in ground color; scutellum brownish, pleuræ, metanotum and legs feebly gray pollinose, halteres yellow. The abdomen is greased, and consequently I cannot give a complete description. In perfect material it is undoubtedly opaque, the ovipositor straight and yellow. Legs largely yellow; the coxæ, the front four femora along the superior border, the hind femora broadly in the middle, and the last joint of all tarsi black. Wings hyaline; stigma yellowish; the small cross-vein slightly beyond the junction of the first and second thirds of discal cell; third section of costa about half the length of the fourth. Length, 3.25 mm.; wing, 4.25 mm.

One specimen, collected in May. I believe that this is a new species, but owing to the discoloration of the abdomen I am unable to describe it fully.

Pipunculus glabrum, n. sp.

Male: Black, mostly shining. Eyes contiguous only for a short distance, occiput, frontal triangle, and face gray pollinose; antennæ black, third joint yellow at tip, acuminate. Thorax black, shining; the mesonotum anteriorly, and the pleuræ superiorly, subshining; humeri and halteres yellow. Abdomen shining black, in certain lights with a bronze reflection, sides and hypopygium with a faint sprinkling of gray pollen; hypopygium uncleft. Legs black, thinly covered with gray pollen, knees, extreme tip of tibiæ, and tarsi, except last joint, yellow. Wings hyaline, small cross-vein about its length in front of the middle of the discal cell, the section of the costa closing the marginal cell about a third as long as the one closing the submarginal cell. Length, 3.25 mm.; wing, 3.5 mm.

One specimen; May.

SCIOMYZIDÆ.

SEPEDON.

(Latreille, Hist. Nat. des Crust. et des Ins., XIV, 305.)

Sepedon scapularis.

Sepedon scapularis Adams, Kan. Univ. Sci. Bull., II, 46; 1903.

Two specimens; May. In my description of this species, where reference is made to the black ring on the hind femora, the term "apex" should be used instead of the word "base," the tip of the femora being black.

Sepedon ornatifrons, n. sp.

Front broader than one of the eyes, excavated, yellowish in the middle, shining bluish black at vertex and on sides; at junction of lower and middle thirds is a velvety black spot on each side, a small blackish dot centrally just above base of antennæ, a fine, hair-like, silvery line coming up from the face on each side and reaching half-way to ocelli; face yellowish, in certain lights with a silvery reflection, with a median bluish-black stripe, a similarly colored, but broader and shining, one from lower corner of eye to oral margin; cheeks yellow, with silvery reflections; occiput bluish black, mostly shining; antennæ black, first joint yellowish at tip; proboscis brownish black, palpi linear, yellow, with apex brownish. Thorax bluish black, with a thin coat of brownish dust; humeri shining, two posthumeral and one supraalar bristle present; scutellum triangular, with an apical pair of bristles; halteres yellow, knobs brown. Abdomen bluish black, with a thin coat of grayish dust. Front coxæ yellow, others brownish; femora yellow, tips black, which color is more extensive on hind femora, extending along the upper margin to the middle, hind femora not unusually thickened, tibiæ and tarsi black, base of front and middle tibiæ slightly reddish. Wings hyaline, tinged with brown along the anterior border, especially prominent distally. Length, 6 mm.

Two specimens.

ORTALIDÆ.

PYRGOTA.

(Wiedemann, Auss. Zweifl., II, 581; 1830.)

Pyrgota abjecta, n. sp.

Female: Head grayish yellow; front broad as one eye, sides parallel, on anterior half with two submedian indistinctly defined, brownish vittæ which are almost contiguous anteriorly; as usual the ocelli are absent, but the ocellar dot is blackish, small ocellar bristles and a pair of small postocellar bristles present; on each side and opposite the ocellar bristles is a pair of small approximated fronto-orbitals, the single pair of vertical bristles strong. Face yellow, just below the antennæ the black median carina is sharp, and below it extends into a broad triangular flat space, this latter is yellowish except on sides. Antennæ reddish yellow, third joint tinged with brown apically. Palpi reddish yellow, proboscis sordid. Occiput yellow, a rather broad blackish vitta from upper angle of each eye to the neck, internally this is bordered by a narrow yellow line, which in turn is bordered internally by two subfused, blackish spots. Thorax yellowish; mesonotum with the reddish-brown vittæ, the middle one narrowing posteriorly and passing onto the scutellum, the lateral ones abbreviated anteriorly and interrupted at the suture, there is a small, similarly colored, spot near base of wing and reaching in front of the suture; one humeral, two notopleural, one presutural, two supraalar, one intraalar, and two dorsocentral bristles on each side; scutellum with two pairs of bristles, the apical ones discussate; pleuræ largely blackish brown, with two mesopleural, one pteropleural, and two sternopleural bristles; halteres yellow. Abdomen subopaque brown, with black bristly pile; sixth segment shining, reddish yellow apically, ovipositor yellow. Legs yellowish, with the femora largely brown. Wings fuscous, marked as follows: A hyaline spot wholly fills out the anal and second basal cells, then narrows and passes across the center of the first basal cell and enters base of marginal cell; the costal cell has two small hyaline dots; at tip of auxiliary vein a hyaline spot starts, broadens in crossing marginal and submarginal cells, narrows across the first basal cell, broadens again in the discal cell, but is here indented distally, and passes some distance beyond the fifth vein; two dots just beyond tip of first vein, opposite these in the submarginal cell in a large hyaline spot, containing a fuscous dot, dividing on entering the first posterior cell into two branches, the distal one ending at the hind cross-vein, the first branch is very irregular in the discal cell, crosses the fifth vein just in front of hind cross-vein, then passes for a short distance toward base of wing; apically the submarginal cell contains three hyaline dots, the first posterior cell five, the second posterior cell three, and the third posterior cell four besides the ones above mentioned. Length, 7 mm.

One specimen; November.

RIVELLIA.

(R. Desvoidy, Myod., 729; 1830.)

Rivellia major, n. sp.

Female: Yellow, with black bristles and pile. Front plane, brownish yellow in the middle, with small black hairs most conspicuous on anterior part, orbits light yellow; ocellar bristles very minute, a fronto-orbital bristle opposite the lower ocellus, a pair of verticals and postverticals present; antennæ long, yellow, third joint acuminate, tip brownish, arista likewise; face yellow, with a median brownish stripe, gently concave; occiput and cheeks yellow, latter with a few short black, bristly hairs; mouth-parts yellow, palpi with a few short black hairs. Thorax yellow; mesonotum and scutellum reddish yellow, a humeral, two posthumeral and two supraalar bristles, scutellum with two pairs of bristles; halteres yellow. Abdomen light yellow, dorsum of first three segments reddish yellow; on the posterior margin of the third segment is a row of rather long black bristles; ovipositor shining black. Legs yellow, tarsi brownish black. Wings hyaline; the costal margin to the tip of the fourth vein is fuscous, a short indistinct fascia from tip of first vein to small cross-vein, another one from just before tip of second vein and passing over posterior cross-vein to hind border of wing, fuscous. Length, 5.5 mm.

Two specimens; October.

TRYPETIDÆ.

DACUS.

(Meigen, Syst. Beschr., VI, 21; 1830.)

Dacus africanus, n. sp.

Male: Close to *D. brevis* Coq. and *D. sigmoides* Coq., from Cape Colony. Head yellow; front reddish yellow in the middle, grayish pollinose along the orbits, ocellar dot, frontal lunule, three spots on orbits, and a spot in center of front, black, the three spots on orbit each bears a black, bristly hair; a vertical and postvertical bristle present; face straight, sloping on the sides; cheeks yellow, and furnished with a black spot below eyes; occiput yellow and reddish yellow variegated; antennæ about as long as head, yellow, tip of third joint and arista largely blackish. Thorax opaque reddish, finely scrobiculate, sparse pile whitish; humeri, a stripe beginning on upper margin of sternopleuræ, traversing the mesopleuræ, and along transverse suture to near middle of mesonotum, a spot on metapleuræ, the scutellum except the extreme base, and halteres yellow; two small spots just in front of transverse suture, two large ones behind it, a stripe just in front of the yellow of the mesopleuræ, the sternopleuræ largely, two spots on metanotum, and metapleura largely blackish; three small black bristles between humeri on anterior margin of thorax, one on side just behind humeri, one at base of transverse suture, one postalar, one intraalar, an apical pair of scutellar bristles, and one mesopleural bristle present. Abdomen reddish, finely scrobiculate, and with whitish sparse pile; third segment laterally along posterior margin with a short row of black bristles; venter yellowish. Legs light yellow; coxæ blackish at base; femora on apical fourth, tibiæ wholly, and tarsi apically, reddish yellow. Wings hyaline; a fuscous stripe along first vein, from base to apex, thence along costa to tip of third vein; and another one along lobe of anal cell to wing margin; auxiliary cell rudimentary; tips of third and fourth veins nearly straight; small cross-vein inclined forward. Length, 7 mm.

One specimen; June.

URELLIA.

(R. Desvoidy, Myod., 774; 1830.)

Urellia confluens.

Trypeta confluens Wied., Auss. Zweifl., II, 510, 56.

Three female specimens, agreeing quite well with the description; October.

Urellia peregrina, n. sp.

Male and female: Head and members yellow; occiput black, frontal orbits, anterior margin of front, face, cheeks and occiput grayish yellow pollinose; front flat, moderately broad, brownish yellow, three fronto-orbital bristles directed forward, a bristle near upper angle of eye, directed backward; apex of third antennal joint rounded, arista brownish, incrassate at base, bare. Thorax black in ground color, covered with gray pollen, pile yellow, larger bristles brownish; scutellum concolorous and with one pair of bristles; halteres yellow. Abdomen black in ground color, gray pollinose, with short yellow pile, ovipositor shining black. Legs yellow, with sparse yellow pile. Hyaline part of wings grayish; the ray from stigma to small cross-vein is nearly obliterated just before it reaches the cross-vein, latter narrowly bordered with brown, second ray arises on the second longitudinal vein and reaches the costa opposite the small cross-vein, there is a rather large hyaline spot just beyond the tip of second vein, the branches of the Y-shaped mark are broad, the base is absent in some specimens, on under side of fourth vein are three well-defined rays, two crossing the second posterior cell, one sometimes joining with the third near its middle, the third is on the posterior cross-vein, there is a remnant of another ray which arises out in the center of the discal cell, sometimes on the small cross-vein, crosses the fifth vein near its middle, but stops short of the wing margin; a large hyaline spot in base of first posterior cell. Length, 3–3.5 mm.

Thirteen specimens; October.

SAPROMYZIDÆ.

PHYSOGENUA.

(Macquart, Dipt. Exot., Suppl. iii, 60; 1851.)

Physogenua bimaculata, n. sp.

Male: Head and members yellow, shining; front broader than one eye, sides parallel, two fronto-orbitals on each side, two verticals, and a pair of small bristles behind the ocelli, ocellar bristles absent; face broad, in profile very similar to *P. nigra* Will., but a little more rounded, and the clypeus not so prominent, three small hairs on each side; third antennal joint elongate-oval, arista nearly equally pubescent on both sides; cheeks broad, bearing several black, bristly hairs. Mesonotum reddish yellow, shining, one humeral bristle, two posthumeral, one presutural, two supraalar, one postalar, three in each outer row of dorsocentrals, two in the two central rows, and a pair of prescutellar bristles; scutellum with four bristles, and two black spots on under side; pleuræ yellow, one mesopleural and two sternopleural bristles present; halteres and legs uniformly yellow, preapical bristles of tibiæ rather strong. Abdomen obscure yellow. Wings hyaline, a small spot at tip of first vein, costa terminates at tip of fourth vein, its third section one-third as long as the second, and nearly as long as the penultimate section of the fourth vein. Length, 3.7 mm.

One specimen; April.

SAPROMYZA.

(Fallen, Ortalidæ; 1820.)

Sapromyza africana, n. sp.

Male: Front as broad as one eye, sides parallel, yellow, with a U-shaped mark whose base is at the ocelli and its arms toward the antennæ, two fronto-orbitals, two verticals, the ocellar and a pair of small postocellar bristles present; face nearly straight in profile, the median carina indistinct, just below the antennæ, on sides opposite them, and the oral margin black, with three small bristly hairs on each side; antennæ two-thirds as long as the face, brownish yellow, third joint dark brown on outer side, elongate-oval, nearly twice as long as broad, arista nearly equally plumose on upper and lower sides; proboscis yellow, tinged with brown; cheeks and occiput yellow. Thorax opaque brown; mesonotum laterally, and two subdorsal lines obscure yellow, one humeral, two posthumeral, one presutural, two supraalar, one postalar, three dorsocentrals, and a pair of small prescutellar bristles present; scutellum obscure yellow, brown on sides at base, with an apical and a basal pair of bristles; metanotum black; halteres yellow; pleuræ obscure brown, one mesopleural and two sternopleural bristles present. Legs yellowish brown, middle coxæ with several strong bristles, anterior femora with five long bristles on posterior margin, middle and hind femora with a row of six short, but strong, bristles on outer side of apical half, preapical bristle of tibiæ strong. Abdomen yellow, posterior angles of first segment, posterior border of following segments, a median vitta on the last three, and the hypopygium largely, black. Wings hyaline, a spot at tip of first vein, one on small cross-vein, two on second and third veins opposite hind cross-vein, the one on the second vein is the larger, another one on the third vein a little way from the tip, another opposite this one on the fourth vein, and one on the hind cross-vein, brown; costa reaches tip of fourth vein, its third section about a third as long as the second, and scarcely as long as the penultimate section of the fourth vein.

Female: Head and thorax yellow; face and cheeks light yellow; mesonotum with two subdorsal, brown vittæ reaching two-thirds way to posterior margin. Abdomen obscure yellowish brown. Otherwise as in the male. Length, 4 mm.

A specimen of each sex; February and April. At first glance one would not suspect that these two specimens represent the same species; but the form of the front, the antennæ, face, the chætotaxy of the front, thorax, and legs, and the wings in structure and markings, are identical.

PACHYCERINA.

(Macquart, Hist. Nat. Dipt. II, 511; 1835.)

Pachycerina vaga, n. sp.

Female: Close to *P. seticornis* Fall. Head yellow; front opaque, a little broader than one eye, with slightly divergent sides, large ocellar dot opaque black, two fronto-orbitals, two verticals, and a pair of bristles behind ocelli present, ocellar bristles absent, minute light brown spot at base of each fronto-orbital, a median brown line from ocelli to antennæ, where it becomes transverse; face shining, with two sublateral black spots, three small bristles on lower part of sides; first joint of antennæ twice as long as second, second with a strong bristle above, third, compared with Becker's figure of *seticornis*, is not so broad at base, and less acuminate at apex, arista black; palpi black, clypeus visible; occiput with brownish line running from near upper angle of eye to neck. Thorax yellow, mesonotum with two subdorsal, two sublateral, and two lateral reddish-brown vittæ, with one humeral, two posthumeral, one presutural, two supraalar, one postalar, two rows of dorsocentrals containing three each, and a pair of prescutellar bristles, there are four rows of small bristly hairs, the two central ones between the two subdorsal vittæ; scutellum yellow, with four bristles; metanotum with two black spots, halteres yellow; pleuræ yellow, with a longitudinal brown vitta, one mesopleural, and one sternopleural bristle present. Legs yellow, tarsi fuscous. Abdomen yellow, tinged with brown. Wings hyaline, with a faint tinge of brown, cross-veins not clouded, costa reaches tip of fourth vein, its third section is about one-third as long as its second, and a little shorter than the penultimate section of the fourth vein. Length, 3.2 mm.

Two specimens. April.

LAUXANIA.

(Latreille, Hist. Nat. des Crust. et des Ins., XIV, 390, 1804.)

Lauxania elisæ.

Lauxania elisæ Meig., Syst. Beschr., 297, 2.

I have not seen this species before, but there is a specimen in the collection which agrees quite well with the description. Along with this one is another, differing only in the yellow front coxæ and femora. Both specimens were collected during October.

SEPSIDÆ.

SEPSIS.

(Fallen, Ortalidæ, 20; 1820.)

Sepsis hirtipes.

Sepsis hirtipes Becker, Ægyptische Dipteren, 142.

Three specimens, agreeing with Becker's description, save that the black of the abdomen is a little more profuse. Collected in May.

Sepsis astutis, n. sp.

Male and female: Head black, shining; besides a pair of ocellar bristles there are two pairs of verticals; antennæ yellowish, apex of third joint obscure, second joint with a bristle above; face, mouth-parts, cheeks and lower part of occiput yellowish; besides the vibrissæ there are two bristles on each side of the mouth. Thorax black; mesonotum subopaque, one humeral, one posthumeral, one supraalar, and two dorsocentral bristles; pleuræ shining, sometimes with a yellowish cast above, with a grayish vitta above coxæ, one mesopleural bristle present; scutellum subopaque black, with an apical pair of bristles; halteres yellow. Front legs yellow, their femora with the usual tubercle beneath, upon which are situated four short black spines, and proximad to which is a single strong spine, the tibiæ with a small swelling on under side near base, bearing a few black bristles; the middle and hind legs shining black, with the coxæ, knees, apices of tibiæ, and tarsi, except their tips, yellowish, middle tibiæ with two short bristles on inner side just beyond middle, hind femora with one bristle on outer side near base of apical third, hind tibiæ also with one bristle on posterior margin near base of apical third. Abdomen shining black, third, fourth and fifth segments each with a pair of submarginal bristles. Wings hyaline, without apical spot, the large vein giving rise to the first, second and third veins enlarged and bordered with brown. Length, 2.7 mm.

Fourteen specimens; February, April, and May.

Sepsis delectabilis, n. sp.

Male: Head shining; front reddish brown, triangle and upper part of occiput black, a shallow median sulcus from tip of triangle to antennæ, with ocellar, two pairs of verticals, and a pair of small bristles behind ocelli present; antennæ reddish yellow, fuscous on upper edge; face, cheeks, mouth-parts, and lower part of occiput yellow, two bristles below vibrissæ. Thorax black; mesonotum largely on the sides, scutellum largely, and pluræ, shining yellow; dorsum of mesonotum subopaque, one humeral, two posthumeral, one supraalar, and two dorsocentrals on each side; scutellum with an apical pair of bristles, and one mesopleural bristle present; a grayish pollinose vitta above middle coxæ; halteres yellow. Abdomen shining, largely black, first, second, anterior angles of third, and anal segment yellowish; third, fourth and fifth segments each with a pair of submarginal bristles. Legs yellow, base of hind tibiæ, and tip of their tarsi fuscous, front femora with the usual tubercle below, which bears four short spines, just proximad to it is a single, stronger bristle, the tibiæ with a small swelling near base, which is covered with small spines, middle tibiæ with a pair of bristles near the middle and a third bristle near base of outer third, hind femora with two bristles on outer side of apical third, hind tibiæ also with a pair on outer third. Wings hyaline, without apical spot, first large vein at base of wing swollen, bordered with brown.

Female: Agrees with the male, except the mesonotum, regardless of the humeri, and the abdomen, except the anterior angles of second segment, are wholly black; also the legs lack the bristles. Length, 3.8 mm.

Three specimens; April and May.

Sepsis propinquus, n. sp.

Male: Head shining black; front with a pair of ocellar and two pairs of vertical bristles; antennæ obscure reddish yellow, third joint with upper margin brownish black; face reddish yellow, oral margin brownish, median carina low; cheeks with a yellowish cast; proboscis brown, with apex yellowish; occiput subopaque above. Thorax black; mesonotum and scutellum subopaque, one humeral, two posthumeral, one supraalar, one postalar, and a pair of scutellar bristles present; pleuræ shining above and grayish below, with one mesopleural bristle; halteres yellow. Abdomen shining black, third, fourth and fifth segments with the usual pair of bristles. Legs black, front coxæ and trochanters, middle coxæ on apical half, and their trochanters yellowish; front femora with the usual tubercle below which bears three short spines, with one strong one proximad and two less strong ones distad to it, the swelling on base of anterior tibiæ small, all tibiæ with two bristles near the middle. Wings hyaline, the large vein at base of wing swollen, bordered with brown, the apical spot at tip of second vein present. Length, 2 mm.

One specimen; May.

Sepsis petulantis, n. sp.

Male: Head shining black; front with a shallow median sulcus anteriorly, a pair of ocellar, and two pairs of verticals present; antennæ yellow, median carina distinct; cheeks and occiput below, yellow, oral margin fringed with a row of short black hairs; mouth-parts yellow. Thorax black; mesonotum, except a spot on anterior margin between humeri, subopaque gray, one humeral, two posthumeral, one supraalar, one postalar, and one dorsocentral bristle on each side; scutellum subopaque, with an apical pair of bristles; pleuræ shining on upper half, silvery on lower, yellowish just below humeri; halteres yellow. Front coxæ and legs wholly yellow, their femora with the usual tubercle, upon which are situated four small spines, and proximad to which is a much stronger spine; the swelling at base of anterior tibiæ small; four hind legs yellow, coxæ at base, femora just beyond middle, middle tibiæ at base, hind tibiæ and tarsi largely blackish; the femora and tibiæ each with a single bristle underneath. Abdomen shining black, third, fourth and fifth segments with a pair of submarginal bristles. Wings hyaline, with a spot at base of first vein and another at apex of second. Length, 2.2 mm.

One specimen; April.

Sepsis rufa?

Sepsis rufa Macq., Dipt. Exot., Suppl. IV, 296.

A single male specimen, which I doubtfully refer to this species. Besides the two pairs of dorsocentrals there are two posthumeral, two supraalar, and a mesopleural bristle on each side, and the scutellum has an apical pair of bristles. Middle and hind tibiæ with only two bristles near center. Otherwise it agrees with Becker's description of *rufa* in his "Ægyptische Dipteren."

AMYDROSOMA.

(Becker, Ægyptische Dipteren, 140.)

Amydrosoma discedens.

Amydrosoma discedens Becker, l. c., 141.

One specimen of this elegant sepsid, collected in May.

DIOPSIDÆ.

DIOPSIS.

(Linne, Diss. Upsal.; 1775.)

Diopsis collaris.

Diopsis collaris Westwood, Trans. Linn. Soc., XVII, 295, 2, tab. IX, fig. 2.

One specimen; October.

Diopsis concolor.

Diopsis concolor Westwood, l. c., 305, 14.

Three specimens; April and May.

Diopsis tenuipes.

Diopsis tenuipes Westwood, l. c., 298, 6, tab. IX, fig. 5.

Two specimens; June.

EPHYDRIDÆ.

NOTIPHILA.

(Fallen, Hydromyz,; 1823.)

Notiphila varitarsis, n. sp.

Male and female: Front dark brown pollinose, with two fronto-orbitals, a small vertical bristle near upper angle of each eye, ocellar bristles strong; occiput, cheeks, and face gray pollinose, cheeks with a strong bristle on lower corner, face with a row of small but distinct bristles on each side; antennæ black, third joint excavated on inner side, arista with ten rays; proboscis brownish black, palpi yellow, clavate, with small black bristles. Mesonotum, upper margin of pleuræ, and scutellum brownish pollinose, remainder of thorax grayish pollinose, two dorsocentral, one humeral, one presutural, two notopleural, two supraalar, one intraalar, and a pair of prescutellar bristles; scutellum with a basal and an apical pair of bristles; halteres yellow. Abdomen brown pollinose, posterior margins of second, third, and fourth segments grayish pollinose, broadly interrupted in the middle, fourth segment with a short median line of the same color, last segment gray on sides, venter largely grayish pollinose. Legs brownish black, knees, middle tibiæ, basal half and extreme tip of hind tibiæ, middle metatarsi, hind metatarsi and the following joint, yellow; middle tibiæ with four bristles externally, hind tibiæ with eight small ones. Wings hyaline, veins black, hind cross-vein straight and about the length of the small cross-vein from the wing margin. Length, 3 mm.

Numerous specimens; May.

Notiphila confinis, n. sp.

Male and female: Front brownish pollinose, two fronto-orbital bristles, a weaker vertical bristle near the eye, ocellar bristles small; occiput and cheeks grayish pollinose, a strong bristle on latter; face grayish-yellow pollinose, with three strong and several smaller bristles on either side, about as broad as long; antennæ yellow, apical half of third joint black, third joint excavated above and internally, spines and bristles of second joint black, arista with eleven rays; proboscis black, palpi yellow, clavate. Thorax uniformly grayish-brown pollinose, on each side two dorsocentrals, one humeral, one presutural, two notopleural, three supraalar, and a pair of prescutellar bristles present; scutellum with a basal and an apical pair; halteres yellow. Abdomen grayish-brown pollinose, two submedian lines on second and following segments dark brown. Legs black, knees, anterior tibiæ except a narrow subapical band, middle and hind tibiæ and tarsi except last two joints, yellow, middle tibiæ with three bristles externally. Wings hyaline, veins brown, a spine at tip of first vein, posterior cross-vein nearly straight, about two-thirds of its length from the wing border. Length, 3.5 mm.

Ten specimens; May and June.

PARALIMNA.

(Loew, Monogr. i, 138; 1862.)

Paralimna nigripes, n. sp.

Male and female: Front, occiput, cheeks, clypeus, a spot descending from between bases of antennæ, and sometimes facial orbits brown pollinose; face gray pollinose; front with four fronto-orbitals on each side, the lower one directed forward; face with two bristles and several small hairs on each side; cheeks with one strong bristle; mouth-parts and antennæ black, arista with thirteen rays. Thorax brown pollinose, mesonotum with numerous small, irregularly placed, yellowish brown spots, three dorsocentrals, one humeral, one presutural, two notopleural, one supraalar, one intraalar, and a pair of prescutellar bristles; scutellum with two pairs of bristles; metanotum gray pollinose; halteres yellow. Abdomen brownish black, segments with an interrupted, gray posterior border; in some specimens the first one or two bands are entire. Legs black, middle femora with three short bristles near outer end, intermediate tibiæ with three bristles. Wings hyaline, veins brown, costa with a spine at tip of first vein, posterior cross-vein straight. Length, 3–4 mm.

Numerous specimens; May and June.

Paralimna ornatipennis, n. sp.

Male and female: Front in center brown pollinose, frontal orbits of a darker shade; between these two shades of brown on each side of the front is a narrow yellowish pollinose line, which at the upper end of lower third of front turns toward eye and enlarges into a white pollinose spot, below which is a large velvety black spot, and on the inner side of this, *i. e.*, next to antennæ, is a small white pollinose dot; also, below the black spot, next to the face and eyes, is a similar silvery dot; the front on the lower third in the middle is subshining; three pairs of fronto-orbital bristles, the middle pair directed forward, one vertical bristle present; face immediately beneath the antennæ shining, the median ridge between the antennæ crested with silvery-white pollen; this ridge at junction of upper and middle thirds of face divides into two short, nearly transverse ridges, between and below which are two small pits; middle portion of face in this neighborhood light brown pollinose, lower two-thirds and sides gray pollinose, sides on lower half with several short and two long bristles; clypeus, cheeks and occiput gray pollinose, the cheeks with black bristles, one long one; antennæ black, third joint slightly pubescent, arista with eleven rays; proboscis swollen, palpi linear, tips yellowish. Mesonotum and scutellum brown pollinose, humeri and small irregularly placed dots gray pollinose; one humeral, two dorsocentral, one presutural, two notopleural, two supraalar bristles on each side, and a pair of prescutellar bristles present, scutellum with a basal and apical pair; pleuræ gray pollinose, with a few irregularly placed brown dots; halteres yellow. Abdomen brown, subshining, posterior border of segments gray pollinose, venter largely so. Coxæ and legs black, moderately covered with gray pollen, first two joints of tarsi yellowish;

middle tibiæ with three bristles. Wings subhyaline, with brown ornamentations; in the marginal, submarginal and first posterior cells are regular, transverse brown spots, the anal portion of wing and the discal cell along the fifth vein uniformly fuscous; on the under side of fourth vein in the discal cell are two spots, and both cross-veins are broadly bordered with brown; costa with a spine at tip of first vein, the second vein with a stump on under side near tip, also, in some specimens, with one on upper side, but at a greater distance from the tip; hind cross-vein straight, perpendicular, about the length of the small cross-vein from the wing margin. Length, 2.5–3.2 mm.

Five specimens; June.

OCHTHERA.

(Latreille, Hist Nat. des Crust. et des Ins., XIV; 1804.)

Ochthera subtilis, n. sp.

Male and female: Black, with violet reflections, largely subopaque. Front, except the orbits, and vertex shining violaceous, orbits brownish pollinose, a strong bristle on occiput near upper angle of eye, occiput and face white pollinose, latter with a few short black hairs, clypeus slender, projecting over the mouth in a sharp angle or point, mouth-parts black, proboscis shining, palpi clavate, with brownish pile; antennæ black, reaching a little over half-way to the facial protuberance. Mesonotum subshining, finely scrobiculate, violaceous and metallic, former color forming two submedian rows separated by a narrow median row of bronze, and two short sublateral rows, partially interrupted at the suture, at which point is a small but distinct yellow spot, sides and posterior portion bronze, on sides and just in front of the scutellum is a smooth, whitish pollinose spot, a small yellow spot in front of scutellum; pile sparse and black, one notopleural, two supraalar and one intraalar bristles on each side; scutellum violaceous, finely scrobiculate and black pilose, an apical pair and a subbasal pair of bristles; pleuræ bluish black, shining below and whitish pollinose above; halteres yellow. Abdomen bluish black, shining, sides of first, second, third, fourth and fifth segments with a white pollinose spot, those on the fifth linear and nearly meeting in the middle; pile along the sides white, venter with reddish reflections, white pollinose in the center. Coxæ and legs bluish black, mostly white pollinose, front coxæ shining externally, front femora much thickened as usual, shining at apex, and with four strong spines on under side at base, the usual small ones present; front tibiæ yellow at base, the spur shining black, front metatarsi largely yellow, and in the male with a pad of black hairs underneath at tip, the following joints and those of the remaining tarsi narrow yellow at base, four posterior knees with a yellowish tinge, pulvilli white, hind metatarsi moderately swollen, free from pile on under side. Wings hyaline, veins dark brown; last section of fourth vein slightly undulate, posterior cross-vein straight, fifth vein scarcely attaining the margin of the wing. Length, 4–5.25 mm.

Numerous specimens; May and June.

CÆNIA.

(R. Desvoidy, Myod., 800; 1830.)

Cænia albifacies, n. sp.

Female: Front brown pollinose, lower corners opaque black, with three fronto-orbitals on each side, the lower one small; face white pollinose, which color ascends up between and above the antennæ; near the middle about half as wide as the front, median carina distinct, five bristles on each side; proboscis black, palpi yellow; cheeks and occiput gray pollinose, former with two rather strong bristles; antennæ black, third joint thin, somewhat bent upon itself, arista with seven rays. Mesonotum and scutellum brown pollinose, humeri and pleuræ gray pollinose, one humeral, three dorsocentral, one presutural, two notopleural, three supraalar on each side, with the usual pair of prescutellar bristles; scutellum with two pairs of bristles; halteres yellow. Abdomen subopaque brown, with a slight metallic reflection, with a sprinkling of gray pollen. Coxæ and legs bluish black, with gray pollen, hind femora shining on inner side, extreme base of posterior tibiæ, and hind metatarsi yellow. Wings grayish hyaline, second vein nearly straight, hind cross-vein straight, about its length from the wing margin, fifth vein not reaching the latter. Length, 2 mm.

Three specimens; May.

DROSOPHILIDÆ.

ZAPRIONUS.

(Coquillett, Proc. U. S. National Museum, xxiv, 32.)

Zaprionus vittiger.

Zaprionus vittiger Coq., l. c., xxiv, 32. Cape Colony, Africa.

Several specimens of this beautiful species, collected during February and April. In perfect specimens the facial carina is also white.

DROSOPHILA.

(Fallen, Geomyz.; 1823.)

Drosophila latifrons, n. sp.

Female: Head and members yellow; front broader than one eye, sides slightly converging anteriorly, opaque, in certain lights with a silvery reflection, three fronto-orbital bristles on each side, middle one small, lower one directed forward, other two upward, two vertical bristles near upper angle of each eye, ocellar bristles strong and pointing forward, a pair of smaller bristles behind the ocelli; antennæ two-thirds as long as the face, third joint about one and one-half times as long as broad, faintly tinged with brown on the upper margin; face subshining, median carina broad and prominent inferiorly, oral margin rounded, prominent, separated from carina by a transverse line. Thorax brownish yellow; one humeral, two posthumeral, two presutural, two supraalar, and one postalar bristle present; scutellum with two bristles on each side; two sternopleural bristles present; halteres and legs yellow. Abdomen obscure, dark brownish yellow, subshining. Wings with a brownish tinge, costa reaches tip of fourth vein, third section of costa about a third as long as the second section, and four-fifths as long as the penultimate section of fourth vein. Length, 3.2 mm.

One specimen; April.

Drosophila quadrimaculata, n. sp.

Male: Head and members largely yellow; front not broader than one eye, frontal triangle opaque yellow, nearly reaching the antennæ, narrowly bordered with brown, sides of front grayish white, four fronto-orbital bristles on each side, the lowest one directed forward, ocellar bristles directed forward, a pair each of vertical and postvertical bristles directed backward, a row of minute hairs just laterad to the fronto-orbitals; third joint of antennæ brownish above and at apex; face with an indistinct median carina; cheeks and occiput slightly grayish pollinose, former very narrow. Thorax yellow, pile black; mesonotum with five longitudinal, brown vittæ, the central one broader than the others and divided longitudinally by a hair-like line, one humeral, two posthumeral, two supraalar, one post-alar and four dorsocentral bristles present; scutellum yellow, with two sublateral, brownish lines, with two pairs of strong bristles; pleuræ with three longitudinal brownish lines, one strong and two small sternopleural bristles; halteres yellow. Abdomen yellow, each segment with a broad apical, brown border, which is continued ventrally, anal segment largely shining black. Legs yellow, tibiæ with a small, but distinct, preapical bristle. Wings hyaline, a small dot at tip of each the third and fourth veins, and each of the cross-veins clouded with brown, costa reaches the fourth vein, third section less than half as long as the second, and not as long as the penultimate section of the fourth vein. Length, 3.7 mm.

One specimen; April.

Drosophila facialis, n. sp.

Male: Head and members yellow; front a little broader than one eye, frontal triangle reaching nearly to the antennæ, not very definitely outlined, three fronto-orbital bristles, small ocellar bristles directed forward, a pair of small postocellar bristles discussate and directed backward; third antennal joint rather short, second with several bristly hairs; facial carina prominent, oral margin bordered with black, vibrissæ strong, facial orbits and cheeks showing a grayish coat; bristly hairs of occiput black. Thorax yellow, pile black; two posthumeral, one supraalar, and a pair of prescutellar bristles; scutellum with two pairs of bristles; one strong and one small sternopleural bristle present. Abdomen yellow, pile black, anal segment, and a small spot on lateral margins of the three preceding segments shining black. Legs uniformly yellow. Wings hyaline, costa reaches tip of fourth vein, third section of costa about one-half as long as the second, and about the length of the penultimate section of the fourth vein, this in turn being a little more than one-half the length of the ultimate section, second and third veins slightly divergent. Length, 2.5 mm.

One specimen; April.

Drosophila basilaris, n, sp.

Male and female: Head and members yellow; front broad as one eye, sides parallel, three fronto-orbitals on each side, two verticals near upper angle of each eye, ocellar bristles strong, a pair of small bristles behind triangle; face excavated, median carina not very prominent; antennæ two-thirds as long as the face, third joint one and one-half times as long as broad, brownish on upper margin; occiput blackish centrally. Thorax reddish yellow; two approximated humeral bristles, two posthumerals, one presutural, two supraalar, one postalar, and a pair of prescutellar bristles; scutellum sometimes with the tip brownish and with two pairs of bristles; pleuræ with a longitudinal brownish band, two sternopleural bristles present; halteres and legs yellow. Abdomen subopaque black, in most specimens the first segment on the posterior half and the second segment on the base yellowish white, in other specimens the first segment is wholly yellow. Wings hyaline, costa reaches tip of third vein, its third section about one-half as long as its second, and about one-fifth longer than the penultimate section of the fourth vein. Length, 2.5 mm.

Ten specimens; April.

Drosophila flaviseta, n. sp.

Female: Reddish yellow, macrochætæ yellowish. Front about three-fourths as wide as one eye, sides parallel, three fronto-orbitals on each side, two verticals near upper angle of each eye, ocellar bristles and a pair of smaller ones behind the ocelli present; face excavated and with a low median carina; antennæ but little more than half as long as the face, third joint notched above; cheeks very narrow. Thorax with one humeral, two posthumeral, two presutural, two supraalar, one postalar, and a pair of prescutellar bristles; scutellum blackish at apex, with four bristles; two sternopleural bristles present. Legs uniformly yellow. Abdomen yellow on basal half, and shining brownish black on apical half. Wings with a brownish tinge, most prominent between costa and third vein, a black spot at tip of first vein, costa reaches tip of third vein, its third section about one-half as long as its second, and slightly longer than the penultimate section of the fourth vein. Length, 3 mm.

One specimen; February.

Drosophila apicifera, n. sp.

Female: Head yellow; front broad as one eye, opaque, three fronto-orbitals on each side, a pair of verticals, and a pair of smaller ones behind ocelli, ocellar bristles strong, ocellar dot black; antennæ nearly as long as the face, third joint twice as long as broad, brownish at apex; face somewhat excavated, median carina barely perceptible; mouth-parts yellow; cheeks narrow. Thorax yellow, pile black; one humeral, two posthumeral, two supraalar, one postalar, and a pair of small prescutellar bristles; scutellum with apex white, convex, with two pairs of bristles; halteres yellow; pleuræ with two sternopleural bristles; legs yellow. Abdomen opaque blackish, pile black, segments yellow on sides at base. Wings hyaline, costa terminating at tip of third vein, third section of costa a little more than one-half the length of the second section, and a fourth longer than the penultimate section of the fourth vein. Length, 3.25 mm.

One specimen; April.

Drosophila mansura, n. sp.

Female: Head and members yellow; front about as wide as one eye, three fronto-orbitals on each side, two verticals, a pair of small bristles behind the ocelli, and a pair of rather strong ocellar bristles present; antennæ three-fourths as long as the face, third joint twice as long as broad; face concave, median carina indistinct; palpi long, viewed from above are broad and with parallel sides, from the side are shown to be thin; cheeks narrow; occiput blackish centrally. Thorax brownish yellow; one humeral, two posthumeral, two supraalar, one postalar, and a pair of small prescutellar bristles present; scutellum with two pairs of bristles; halteres yellow; two sternopleural bristles present; legs yellow. Abdomen yellow, posterior borders of second, third, fourth and fifth segments shining black. Wings hyaline, costa reaches tip of third vein, its third section about one-half as long as its second, and little longer than the penultimate section of the fourth vein. Length, 2.5 mm.

One specimen; April.

Drosophila palpalis, n. sp.

Male: Head yellow; front broad as one eye, three pairs of fronto-orbitals, the lower pair directed forward, two pairs of verticals, ocellar bristles directed forward; third joint of antennæ twice as long as broad; facial carina scarcely perceptible; palpi black, elongate, acute when viewed from the side, broad and rounded from above. Thorax yellow, pile black; mesonotum reddish yellow, with a median gray pollinose vitta, one humeral, two posthumeral, one supraalar, and one postalar bristle; scutellum with two pairs of bristles; pleuræ with a thin coating of gray pollen, two sternopleural macrochætæ present; halteres and legs yellow. Abdomen opaque black, each segment centrally and on posterior border yellowish. Wings hyaline, costa terminates at tip of third vein, its third section a little more than one-half as long as its second, being one and one-fourth times as long as the penultimate sections of the fourth vein. Length, 2 mm.

One specimen; April.

Drosophila proxima, n. sp.

Female: Head and members yellow; front opaque, with three fronto-orbitals on each side, two verticals and a pair of small bristles behind the ocelli, ocellar bristles rather strong; antennæ about two-thirds as long as the face, third joint nearly twice as long as broad; face excavated, median carina perceptible just below the antennæ only; cheeks narrow; occiput black with orbits largely yellow. Thorax reddish yellow; mesonotum with one humeral, two posthumeral, two supraalar, one postalar, and a pair of small prescutellar bristles; scutellum with two pairs of bristles, its apical fourth is white, between this and the remainder of the scutellum is a streak of brown; knobs of halteres brown; two sternopleural bristles present. Legs yellow. Abdomen yellow; second segment with a black spot laterally, brownish in the middle, third and fourth segments with the posterior border shining black, which color extends forward centrally, last segment with the posterior border black. Wings hyaline, costa reaches to tip of third vein, its third section about one-half as long as its second, and a little longer than the penultimate section of the fourth vein. Length, 2.7 mm.

Three specimens; April.

Drosophila mutabilis, n. sp.

Male and female: Yellow, in certain lights the entire body is sericeous; front with parallel sides, sometimes the sides only show silvery, two verticals and three fronto-orbitals on each side; the upper one of the latter is nearly opposite the lower ocellus and directed backward; the other two are very close together, nearly half-way between ocelli and antennæ, directed backward and forward respectively; ocellar bristles small; face scarcely broader than the front, slightly excavated, orbits narrow; antennæ about three-fourths as long as the face, third joint elongate-oval, arista with seven pectinations above and three below; proboscis fleshy, palpi linear, with a few apical bristles; cheeks narrow. Mesonotum with very short black pile, a humeral, two posthumeral, one supraalar, and one postalar bristle; scutellum with the posterior border somewhat oval, and with an apical pair of bristles; pleuræ with a pair of sternopleural bristles; halteres yellow, sometimes with blackish knobs. Abdomen yellow, with considerable variation, in either sex, as to the black markings; some specimens show two large lateral, and one small central spot on fourth segment, and three small ones on fifth segment; others agree with the foregoing with the addition of two sublateral spots on the second segment; others agree with the first set with the addition of a large central spot on the third, and a small central one on the sixth segment; others have the abdomen wholly yellow, and one specimen has the third and fourth segments wholly black. Legs yellow, front femora with from three to four strong bristles on under side. Wings hyaline, costa reaches tip of third vein; the female usually has a small dot at tip of first vein, the male wing as follows: Near the base there is a prominent black spot reaching from costa to fifth vein, the small cross vein is narrowly surrounded by brown; just proximad to the tip of the second vein is a large quadrate spot reaching to the third vein, then it narrows and crosses the first posterior cell to join a large subquadrate spot around the hind cross-vein; the latter spot attains the wing margin just beyond the tip of the fifth vein; the angle between the third vein and the costa is filled out half-way to the tip of the second vein; in the second posterior cell and near tip of fourth vein is a tinge of brown, the apex of the first posterior cell, the base of the second, the hyaline portion just beyond the tip of the second vein, and hyaline portion from small cross-vein to costa, are in certain lights tinged with gray. Length, 2.5 mm.

Numerous specimens; February and April.

Drosophila pallida.

Drosophila pallida Will., Dipt. St. Vincent, 415. St. Vincent.

Having had access to the types of *pallida*, I have little doubt that my determination is correct. There is a greater variation, however, in the coloration of the abdomen, there being a gradual gradation from specimens with regular bands on posterior borders of segments to those with the abdomen uniformly brown.

Numerous specimens.

ASTEIA.

(Meigen, Syst. Beschr., V, 88; 1830.)

Asteia longipennis, n. sp.

Male: Wholly yellow, except the abdomen is of a brownish cast. Front broad, bristles very short, except the large ocellar pair; antennæ short, third joint cordate, second joint with a strong bristle on the upper side and smaller ones beneath at apex (arista broken off): face broad, slightly concave in profile, with an indistinct median carina, oral cavity rather large, clypeus visible, proboscis short. Thorax with two blackish bristles on side of mesonotum near base of wing, and one on pleuræ, a little below and behind the humeri; scutellum with an apical pair of rather long bristles and a smaller one on either side. Abdomen of a brownish cast, except the hypopygium, which is yellow. Legs wholly yellow. Wings hyaline, twice as long as the abdomen, slender, anal angle not prominent, tips of first and second veins about the length of the small cross-vein distant from each other, third and fourth veins parallel, costa reaches tip of fourth vein, posterior cross-vein and anal cell wholly wanting. Length, 2.25 mm.; wing, 2.5 mm.

One specimen; May.

OSCINIDÆ.

CRASSISETA.

(Von Roser, Verz. Wurtt. Dipt. Nachtrag; 1840.)

Crassiseta tarda, n. sp.

Front, including the triangle, yellow, ocellar dot blackish, on sides and in front with yellowish, bristle-like hairs, frontal triangle subshining, reach two-thirds way to the antennæ; face yellow, slightly excavated, and with a low median carina, vibrissæ present; cheeks narrow, yellow, in certain lights silvery, occiput yellow, two submedian, brownish marks above neck; antennæ yellow, narrow upper border of the third joint, and arista black, arista not so prominently thickened as in most species of *Crassiseta;* mouth-parts yellow. Thorax reddish yellow, largely shining, short pile yellow, two bristles in front base of wing and two above black, scutellum with four small tubercles, each bearing a bristle, halteres yellow. Abdomen shining brownish black, venter at base in one specimen yellowish. Legs wholly yellow. Wings hyaline, third section of costa a little shorter than the second. Length, 2 mm.

Two specimens; May. This is very close to *C. flavida* Will., from St. Vincent, W. I. The arista is shorter than in *flavida*, and the frontal triangle is much shorter and less shining; otherwise they are very similar.

Crassiseta scapularis, n. sp.

Front opaque brown on upper half, yellow on lower, bristly hairs on sides and in front, triangle shining black, reaching two-thirds way to antennæ, face and cheeks yellow, grayish pollinose, former nearly plane, vibrissæ present, occiput black above, yellow below, antennæ yellow, arista black, mouth-parts yellow. Thorax black, humeri and line in front of base of wing yellowish, mesonotum, scutellum, and pleuræ above thinly grayish pubescent, one humeral, two posthumeral, and two supraalar bristles present, scutellum with a minute apical pair of tubercles, from which arise a pair of bristles, a smaller bristle on each side, halteres yellow. Abdomen subshining black, venter yellowish. Legs light yellow, front tarsi and tip of following pairs black. Wings hyaline, second and third sections of costa of equal length. Length, 1.8 mm.

Two specimens; April.

Crassiseta conjuncta, n. sp.

Front moderately broad, not projecting, opaque yellow, with a mixture of small black and yellowish bristles, frontal triangle narrow, reaching the antennæ, shining yellow, ocellar dot brownish black; face yellow, orbits silvery pollinose, with a pair of blackish vibrissæ; cheeks narrow, yellow, silvery pollinose, with a few small, blackish bristles; occiput yellow, silvery pollinose below, with two divergent brown marks above; antennæ yellow, second joint with several small, yellowish bristles and a larger black one, arista black, two jointed; mouth-parts wholly yellow. Thorax yellow; mesonotum, except humeri and broadly on sides, black, thin coat of microscopic, yellowish hairs, short pile yellow, two posthumeral and two supraalar bristles black; scutellum black on dorsum, microscopic hairs and longer pile yellow, a pair of tubercles on apex and two smaller ones on each side, each bearing a blackish bristle, the apical pair being the largest; halteres yellow; pleuræ largely shining. First and second segments of abdomen ankylosed, the second very large, deeply concave anteriorly for the reception of the convex first segment, these two segments compose most of the abdomen, posterior angles of second very prominent, lateral margins of both and posterior border of second black, following segments short, and decreasing in width very rapidly, shining black; sparse pile yellow. Legs yellow, front tarsi largely, and last two joints of middle and hind tarsi black. Wings hyaline, second section of costa a little shorter than the third. Length, 2.5 mm.

Two specimens; February and April.

Crassiseta atricornis, n. sp.

Front opaque, brownish black, anterior part yellowish, orbits somewhat grayish, small black bristly hairs on sides and anterior part, triangle shining black, reaching two-thirds way to antennæ, ocellar dot grayish pubescent; face excavated, blackish, vibrissæ present; cheeks narrow, oral margins projecting, with a faint yellowish cast; occiput black, grayish pubescent; antennæ wholly black; mouth-parts yellowish. Thorax black, largely shining, with one humeral, two posthumeral, and two supraalar bristles; mesonotum and scutellum with a uniform grayish coat, latter with two long and two short bristles, halteres yellow. Abdomen black, subopaque. Legs wholly black.

Wings hyaline, with a grayish tinge, veins brownish black, second section of costa a little longer than third, small cross-vein nearer to base of third vein than to hind cross-vein. Length, 2 mm.

Crassiseta tuberculata, n. sp.

Front opaque black, yellowish on anterior part, small bristly hairs on sides and in front, triangle shining black, reaches four-fifths way to antennæ, with a pubescent stripe passing diagonally from ocelli to center of each side; cheeks narrow, black, grayish pubescent; occiput black; antennæ yellow, arista black, longer than usual, acuminate; mouth-parts brownish black. Thorax black, two posthumeral and two supraalar bristles, mesonotum, scutellum and upper part of pleuræ uniformly grayish pubescent, scutellum with four prominent tubercles, each bearing a rather strong bristle, halteres yellow. First two segments of abdomen yellowish above and below, with their lateral margins black, following segments shining black. Legs yellow, middle and hind femora toward apex, and tip of tarsi brownish. Wings hyaline, second section of costa slightly longer than the third. Length, 2.2 mm.

One specimen; October.

Crassiseta vulgaris, n. sp.

Front opaque yellow below, brownish above, orbits somewhat grayish, a row of short black bristles on each side reaching almost to antennæ, other small black hairs on anterior part, triangle shining black, reaching two-thirds to antennæ, ocellar dot grayish pubescent; face excavated, blackish, a pair of vibrissæ present; cheeks narrow, yellow, oral margin slightly projecting; occiput black above, yellow below; antennæ yellow, upper side of third joint and arista black; proboscis blackish, palpi yellow. Thorax black, largely shining, mesonotum and scutellum with a uniform thin coat of grayish pubescence; two posthumeral and two supraalar bristles present; scutellum non-tuberculate, with one pair of large and a small pair of bristles; halteres yellowish white. Abdomen black, subopaque, venter sometimes yellowish at base. Legs largely yellowish, the femora and hind tibiæ sometimes brownish, tips of tarsi blackish. Wings hyaline, veins dark brown, second section of costa a little longer than the third, small cross-vein nearer to the furcation of the second and third veins than to the hind cross-vein. Length, 1.7 mm.

Numerous specimens; October.

Oscinis.

(Latreille, Nouv. Dict. d' Hist. Nat., XXIV, 196; 1804.)

Oscinis polita, n. sp.

Front opaque black, narrow anterior border with a yellowish cast, bristly hairs on sides and in front short, triangle shining black, large, almost reaching the antennæ, and nearly contiguous with eyes above; face, cheeks and occiput black, with grayish reflections, vibrissæ present; antennæ and mouth-parts black. Thorax black, mesonotum and scutellum subopaque, grayish pubescent, former with two posthumeral and two supraalar bristles, latter somewhat shortened and convex, with four bristles; halteres yellow. Abdomen subopaque black. Legs black, knees, tibiæ, and tarsi, except their tips, yellow. Wings hyaline, with a slight grayish tinge, second and third sections of costa of about equal length. Length, 1.5 mm.

One specimen; May.

Oscinis basilaris, n. sp.

Front opaque brown above and yellow below, with black bristly hairs on sides and in front, triangle shining black, reaching two-thirds to antennæ; face light brown, with a low median carina, vibrissæ present; cheeks narrow, yellowish, in certain lights silvery; occiput black, covered with grayish pollen; antennæ wholly black; proboscis brownish black, palpi yellow, clypeus black. Thorax black, largely shining, humeri, pleuræ partially, and sides of scutellum yellowish, mesonotum and scutellum with a thin coat of grayish pubescence, latter with an apical pair of bristles, a shorter, hair-like bristle on each side; halteres yellow. Abdomen brownish black, shining, two basal segments largely yellowish. Legs yellow, all femora and tibiæ with a brownish cast near the middle, last two joints of tarsi fuscous. Wings hyaline, second and third sections of costa of about equal length. Length, 1.9 mm.

Two specimens; October.

ANATRICHUS.

(Loew, Bidrag til kanned. om Afr. Diptera, 97, 7.)

Anatrichus erinaceus.

Anatrichus erinaceus Loew, Bidr. t. känned. om Afr. Dipt., 97, 7, 13.

Three specimens of this peculiar insect; May.

MEROMYZA.

(Meigen, Syst. Beschr., V, 163.)

Meromyza opaca, n. sp.

Front fulvous, broader than one of the eyes, minute black hairs on anterior part, with a silvery line along the eye, triangle opaque, grayish pollinose, reaching nearly to the anterior margin of front; antennæ brownish yellow, third joint more or less rotundate, brown on upper side at tip, arista basal, brownish black; face with a small median carina, on each side of which the ground color is blackish, remaining parts yellow, and all covered with whitish pollen; mouth-parts yellow; cheeks and occiput yellowish, latter with a black mark on each side of center above, both with silvery or gray pollen. Thorax opaque grayish brown; mesonotum with hair-like, light grayish-yellow lines, diverging posteriorly, the middle one attaining the tip and the other two the sides of the scutellum, mesonotum covered with microscopical black hairs, the sides and the pleuræ grayish pollinose; halteres brownish, knobs white; scutellum with an apical pair of small bristles. Abdomen yellowish brown, dorsum of segments each with a large dark brown triangle at base, the apex of which attains the posterior margin. Coxæ brownish black, four front femora generally yellowish, sometimes with a brownish ring near center, hind femora black, apex yellow, shining on inner side; tibiæ and tarsi, except last joint of latter, yellow. Wings hyaline, veins fuscous, third and fourth veins divergent. Length, 4 mm.

Numerous specimens; October.

PACHYLOPHUS.

(Loew, Berl. Ent. Zeitschr., II, 121.)

Pachylophus splendida, n. sp.

Front long, projecting in front of the eyes a third of their greatest diameter, broader than one of the eyes, excavated, vertex prominent, black, a silvery line on each side next to the eye; anterior broader, narrowly yellow, frontal triangle shining, reaching nearly to the antennæ; antennæ black, lower half of third joint yellow, second joint somewhat cup-shaped on distal end for the reception of the third joint, arista black; face gently receding, forming with the front an angle of about forty-five degrees, black, covered with gray pollen, the median carina reaching from front to oral margin; mouth-parts small, black; cheeks and occiput black, covered with gray pollen; eyes elongate-oval. Thorax black, opaque; mesonotum with a pair of subdorsal, narrow, gray pollinose lines, which are slightly divergent posteriorly, on the sides, and the pleuræ gray pollinose; halteres with brown base and whitish knobs. Abdomen wholly black, subopaque. Legs black, base and tip of middle tibiæ, middle and hind tarsi, except last joint, yellowish. Wings hyaline, with a very faint tinge near apex, second vein joins costa nearly opposite hind cross-vein, third and fourth veins straight, gently divergent; wings rather narrow. Length, 4 mm.

One specimen.

Pachylophus proxima, n. sp.

Front broad and short, not projecting in front of the eyes, slightly excavated, with a few minute hairs on anterior part, brownish yellow on anterior margin and lower half of sides, with a narrow silvery line along orbits, frontal triangle long and broad, covering most of the front, shining, bluish black; face nearly perpendicular, the oral margin slightly projecting, black, moderately shining; cheeks blackish, with a yellowish cast just below the eyes, shining, about one-fifth as high as the eyes; occiput black, whitish pollinose along the eyes; antennæ black, lower anterior angle of second joint, and the lower side of the third joint yellow, end of second joint somewhat cup-shaped, arista black; compact, composed of three sections; mouth-parts black. Thorax black, mesonotum subopaque, with two subdorsal gray pollinose lines diverging posteriorly, which are finally connected by the posterior border being rather broadly pollinose, sides, from humeri to scutellum, gray pollinose, which join the subdorsal lines anteriorly; scutellum largely covered with pollen; pleuræ shining; halteres brownish at base, knobs white. Abdomen black, subopaque. Legs black, the four anterior knees, tips of all tibiæ, and tarsi yellow. Wings as in the preceding species. Length, 3.25 mm.

Numerous specimens; October.

Pachylophus varipes, n. sp.

Front broader than one of the eyes, short, scarcely projecting in front of the eyes, yellowish on the anterior margin and lower half on the sides, the silvery hair-like line along the orbits scarcely visible, absent in some specimens, a few minute black hairs on sides and in front, triangle long and slender, plane, shining black; face straight, forming with the front an angle of about ninety degrees, oral margin not projecting, brownish black; cheeks narrow, with a yellowish cast, covered with grayish pollen; occiput black, grayish pollinose; antennæ black, third joint yellow on the lower side, arista two-jointed; mouth-parts yellow. Thorax black, mesonotum and scutellum uniformly gray pollinose, pleuræ partly shining; halteres yellow. Abdomen black, subopaque, with a thin coat of dust. Legs largely yellow, in some specimens the front and hind femora are largely black, last joint of all tarsi black, hind femora only moderately incrassate. Wings grayish hyaline, third and fourth veins straight, gently divergent, second section of costa shorter than the third. Length, 2.4 mm.

Numerous specimens; May.

Pachylophus fossulata, n. sp.

Front a little broader than one eye, not projecting, yellowish on anterior margin and on lower half of sides, triangle shining black, reaching nearly to the antennæ, contiguous with the eyes above, and containing two, sometimes one large one, small fossæ, one at apex and one near middle; face nearly straight, with a brownish-yellow cast, sides grayish pollinose; cheeks small, yellowish, gray pollinose; occiput black, gray pollinose; mouth-parts yellow; antennæ largely yellow, upper margin and apex of third joint, and arista, black, latter composed of two joints. Thorax black; mesonotum and scutellum finely scrobiculate; pleuræ smooth, shining; halteres brownish, knobs sometimes yellowish on inner side. Abdomen black, dorsum of first two segments, sometimes the third also, more or less of a yellowish cast. Coxæ and legs yellow, front tibiæ, except extreme base, front tarsi and last two joints of hind tarsi black. Wings grayish hyaline, veins brownish, second section of costa a little shorter than the third, third and fourth veins slightly divergent, cross-veins a little more approximated than in the other species. Length, 3 mm.

Numerous specimens; May.

Pachylophus frontalis.

Pachylophus frontalis Loew, Berl. Ent. z, 121.

Numerous specimens; October.

HAPLEGIS.

(Loew, Schles. Zeitschr. f. Ent. (22); 1866.

Haplegis scutellaris, n. sp.

Front broader than one eye, moderately projecting anteriorly, yellow, frontal triangle shining black, large, contiguous with the eyes above, suddenly narrowing to an acute angle anteriorly, which reaches nearly to the antennæ; face moderately receding, light yellowish, whitish pollinose; cheeks narrow, yellowish, white pollinose; occiput black, yellow on lower angles; antennæ largely yellow, upper anterior angle of third joint black, third joint quadrangular, nearly twice as long as broad, arista basal, bare, brownish black; proboscis brownish black, palpi yellow. Thorax shining black, a spot behind humeri, one above front coxæ, a narrow line above middle coxae, and scutellum yellow; one humeral and two posthumeral bristles present; knobs of halteres yellow. Abdomen shining black. Legs black, coxæ, base and tip of all femora and tibiæ, and tarsi wholly, yellow. Wings hyaline, veins brown, second section of costa nearly twice as long as the third, small cross-vein nearly under the tip of first longitudinal vein, third and fourth veins straight, nearly parallel. Length, 2 mm.

One specimen; October.

CHLOROPS.

(Meigen, Illig. Mag., II, 278.)

Chlorops trimaculata, n. sp.

Front nearly twice as broad as one eye, moderately projecting before the eyes, yellow, with a few small black hairs, frontal triangle reaching nearly to the antennæ, yellow, with a shining black spot on each angle, the two upper ones triangular, the lower one larger and diamond-shaped; face, cheeks and occiput light yellow, latter reddish yellow above, with a brownish triangular marking on each side above the neck; mouthparts and clypeus yellow; antennæ about as long as the face, reddish yellow, apex of third joint black, arista rather short and thick. Thorax yellow, mesonotum with three broad, reddish-yellow vittæ, the two lateral ones abbreviated anteriorly, the central one posteriorly, a few black, bristly hairs in front of and above base of wing; scutellum reddish yellow on disk, besides an apical pair there are two small bristles on each side; pleuræ with a small shining black spot above front coxæ; halteres yellow. Abdomen reddish yellow throughout. Legs yellow, last two joints of all tarsi black. Wings hyaline, veins brown, second and third sections of costa somewhat swollen, former three-fourths as long as the latter. Length, 2.5 mm.

One specimen; October.

AGROMYZIDÆ.

Rhodesiella, gen. nov.

Head hemispherical; eyes oval, bare, occupying whole of height of head; cheeks very narrow; front a little broader than one eye, with three rows of short bristles on each side; face nearly perpendicular, slightly concave, with the oral margin moderately projecting, vibrissæ present; antennæ short, third joint orbicular, arista distinctly pubescent; proboscis short and fleshy, clypeus projecting, palpi clavate. Mesonotum minutely punctulate, with macrochætæ only on the sides; scutellum large, swollen, subtriangular, more distinctly punctate, spinous tubercles on sides near apex, with an apical pair of divergent bristles. Abdomen short and broad, composed of five segments. Costa reaches tip of fourth vein; auxiliary vein rudimentary, joining the first vein near its center; first vein ending a little before the middle of the wing, second, third and fourth veins curving forward, the latter ending before apex of wing, second and fourth sections of costa of about equal length, third nearly as long as both together; hind cross-vein beyond middle of wing; discal and second basal cells united, anal cell rudimentary. Femora with an external row of short bristles. Type, the following species.

Rhodesia tarsalis, n. sp.

Female: Shining black, with short yellowish pile. Front smooth, shining purple, ocellar bristles present, and a pair of rather strong verticals differentiated from the fronto-orbitals; antennæ black, under side of third joint reddish brown; face shining black. Thorax with one humeral, two posthumeral, one supraalar, and one postalar bristle on mesonotum; pleuræ smooth, halteres black. Abdomen shining black, compressed, with yellowish pile. Legs shining black, coxæ and anterior knees with a reddish cast, all tarsi light yellow. Wings hyaline, the ultimate and penultimate sections of the fourth vein forming quite an angle at the hind cross-vein, base of ultimate section slightly undulate. Length, 2.75 mm.

One specimen; February.

BORBORIDÆ.

BORBORUS.

(Meigen, Illig. Mag., II, 276.)

Borborus marginatis, n. sp.

Female: Front twice as wide as one eye, grayish pollinose on sides, triangle reaching anterior margin, and yellowish pollinose, between the triangle and the grayish the front is opaque brownish black, upon which is a row, on either side, of short bristly hairs, also a row of similar hairs of gray orbits; two backwardly curved fronto-orbitals and one vertical bristle on each side, ocellar bristles present. Face excavated, with a low median carina, subshining, grayish pollinose, yellowish in ground color along oral margin, vibrissæ strong. Cheeks and occiput black, grayish pollinose, with short black hairs. Antennæ black, third joint orbicular, reddish yellow underneath, arista microscopically pubescent. Mouth-parts subshining black, clypeus yellow anteriorly. Thorax black, yellowish pollinose, three subpollinose vittæ on mesonotum; one humeral, two posthumeral, one supraalar, one postalar, and a pair of prescutellar present; besides these there are six rows of short bristles on the mesonotum; scutellum with four bristles. Sternopleuræ subshining; halteres yellow. Abdomen black, grayish-yellow pollinose; second segment somewhat elongate, remaining segments of equal length, except the fifth, which is a little shorter than the fourth. Legs black, grayish pollinose; front coxæ shining; front and middle knees and middle tarsi, except last two joints, yellowish; all femora and front and middle tibiæ ciliated with bristly hairs, the hind tibiæ with the usual apical spine and two subapical bristles; hind metatarsi swollen as usual, and scarcely longer than following joint. Wings hyaline, tinged with a faint yellowish brown; costa distinctly ciliated as far as the tip of the first vein; small cross-vein a little beyond the tip of the first vein, last section of fourth vein a fifth longer than the penultimate. Length, 2.7 mm.

Borborus gravis, n. sp.

Male and female: Front broader than one eye, triangle reaching anterior margin, and with the frontal orbits grayish pollinose, remainder of front opaque black, with a shining line on the anterior part, just laterad of triangle, and bearing a row of short bristly hairs, also a row of gray orbits; two fronto-orbitals, two verticals, and a pair of ocellar bristles present. Face, cheeks and occiput black, subshining, grayish pollinose; former concave in profile, with a low median carina, vibrissæ strong. Mouth-parts black. Antennæ black, third joint subglobular, sometimes with a reddish tinge on inner side at base, arista microscopically pubescent. Thorax from posterior view subshining, from front view opaque, brownish pollinose, with two submedian grayish lines; one humeral, two posthumeral, one presutural, one supraalar and three dorso-central bristles on each side, the small bristly hairs arranged in six rows; scutellum with four bristles; halteres yellow. Abdomen subopaque black, grayish pollinose, second segment elongate. Legs black, anterior and middle knees and middle tarsi, except the last two joints, yellowish; femora and tibiæ armed with bristles, middle tibiæ with one near middle and three near apex, hind tibiæ with two strong bristles apically beside the curved apical spine. Wings hyaline, costa slightly thickened just beyond tip of first vein, and distinctly ciliated in front of it, small cross-vein a little distad to tip of first vein, and last section of fourth vein but little longer than preceding section. Length, 2.1 mm.

Four specimens; February.

LIMOSINA.

(Macquart, Suites a Buffon, II. 571, 8; 1835.)

Limosina marginata, n. sp.

Male and female: Front reddish yellow, ocellar dot and vertex black; orbits of a grayish luster; three fronto-orbital bristles, all curving backward, the upper one large; a vertical and two postverticals on each side; besides the strong ocellar bristles there are several smaller ones behind ocelli; on anterior part of front there are two submedian rows of bristles, each containing three, the lowest one of which is strong; among the fronto-orbitals are a few bristly hairs; third antennal joint reddish yellow, arista pubescent. Face yellowish, concave in profile, carina prominent, vibrissæ strong. Cheeks yellowish, with yellow pollen; half as high as eye and bearing three strong and several weak bristles. Mouth-parts yellow, proboscis fleshy, palpi subclavate, bearing several bristles. Occiput black, yellowish on lower part. Thorax dark brown opaque; mesonotum with lateral margins, except just behind the humeri, yellowish, and four longitudinal brownish-yellow pollinose vittæ; one humeral, two posthumeral, two presutural, two supraalar, one postalar, a small prescutellar, and five dorsocentrals on each side; scutellum subshining black centrally, margins broadly yellow; three strong, three weak, and three bristly hairs on each side; pleuræ dark brown, yellowish along various sutures, with two sternopleural bristles; halteres yellow. Abdomen subopaque black, with rather strong bristly hairs on lateral margins. Legs brownish black, coxæ, knees, tibiæ and tarsi yellowish; front femora with three bristles on under side near tip, middle with a strong bristle near base, middle tibiæ with from eight to ten very strong bristles or spines on outer side, each joint of middle tarsi with one or two spinous bristles on apex; hind tibiæ with five bristles along posterior margin. Wings with a fuscous tinge; first section of costa with six short bristles, second section twice as long as the third; small cross-vein nearly opposite the midpoint of the second section of the costa. Length, 3 mm.

Six specimens; April and May.

Limosina venalicia.

Borborus venalicius O. S., Cat. N. Am. Diptera, 263.

One soiled specimen, which I believe belongs here. The markings of the head and the mesonotum are obliterated, and on this account its identity is uncertain. The general color, the markings on the legs, and the wings, are comparable very well to the description of Osten Sacken's species, and its identity is very probable.

MUSCIDÆ.

PARACOMPSOMYIA.

(Hough, Proc. Acad. Nat. Sci. Phil., 1898, p. 184.)

The males in this genus have an area of enlarged facets, eyes subcontiguous. The costa is black only in *nigripennis*, the type of the genus. In the remaining species, described herein, the base of the wing only is black.

Paracompsomyia nigripennis Hough, l. c., p. 184.

In the collection before me are four specimens agreeing in all particulars with Hough's description. The male, of which Hough had no representative, is a fraction smaller than the female; the large faceted area is sharply marked off, occupying the upper two-thirds of the eye, and is ferruginous in color; the remainder of the eye is dark brown.

January.

Paracompsomyia houghi, n. sp.

Male and female: Smaller than *nigripennis*, 8 to 10 mm., wing, 7.5 mm. Largely metallic green, with bluish and violet reflections on thorax and base of abdomen. Head black, subshining below lower angle of eye, grayish pollinose except on frontal vitta and upper part of front, and white pilose. Area of large facets not sharply marked off. Antennæ and legs black, latter sometimes brownish in the female. Wings hyaline, base, as far as tip of small basal cells, blackened. Thorax with a sheen of white dust, most prominent in front of the suture, pile black. On front part of thorax are two opaque, black, angular lines, meeting centrally on anterior margin, so as to form a /\-shaped figure; just in front of the suture each turns outward, broadens, and becomes club-shaped. The space between these lines shows, in certain lights, metallic green.

Just behind the suture is an opaque black line, not reaching the lateral margin, but sending back a short projection at each end. Abdominal segments each with an opaque band on apical margin, those on basal segments being broadest; pile whitish. Pile of base of femora whitish, on remainder of legs, black. Base of scutellum subopaque black. Chætotaxy same as in *nigripennis*, except there are only three marginal bristles on scutellum.

Fourteen males and six females; September. Dedicated to Doctor Hough, the author of the genus.

Paracompsomyia splindida, n. sp.

Male and female: Smaller than *houghi*, 7 to 9 mm., wing, 7 mm., green, with violet reflections. Head shining black, sides of face and lower part of occiput grayish dusted; pile black; antennæ very dark brown; area of large facets occupying upper half of eye, and light brown in color. Thorax blackish green with violet reflections, in center of anterior margin is a triangular metallic green spot, which in certain lights shows a coat of white pollen. Pile of thorax and abdomen very short and black. Abdomen green, usually with violet reflections on base and sides, venter light pollinose. Legs blackish green or violet. Wings hyaline, extreme base lightly infuscated. Chætotaxy same as in *nigri pennis*, exceptonly two dorsocentrals, scutellum without discal bristles, and with only two marginals. Halteres light brown.

Numerous specimens; January.

Paracompsomyia verticalis, n. sp.

Female: Metallic green, with the transverse suture, posterior angles of mesonotum, base of scutellum, and posterior border of each abdominal segment showing a very thin coat of light pollen. Vertex and occiput black, remainder of head ferruginous, with whitish pile and silvery pollen. Antennæ and proboscis blackish, palpi yellowish. Legs brownish black. Wings hyaline, except on base, which is clouded. Chætotaxy same as in *houghi*, from which species it differs principally in the color of the head. Length, 7.5 mm.; wing, 6 mm.

One specimen; January.

ANTHOMYIDÆ.

SPILOGASTER.

(Macquart, Hist. Nat. Dipt., II, 293; 1835.)

Spilogaster osten-sackenii, Jaen. Neue Exot. Dipt., 371, 77.

Numerous specimens of each sex, which I identify as Jaennick's species. The males have the markings of thorax and abdomen opaque black, instead of brownish black as in the female. Among the lot are several males of smaller size, 4.5 mm., and with wings more clouded; otherwise, they are the same throughout.

April, May, and June.

Spilogaster tripunctata?

Anthomyia tripunctata Wied., Auss. Zweifl. Ins., II, 422, 2.

A female specimen agrees with Wiedemann's *A. tripunctata* in all particulars except the legs, which are of a uniform dull yellowish cast, and tarsi black. Whether I am correct in my identification or not, I cannot say, but my specimen agrees so closely to Wiedemann's description that I do not feel justified in describing it as new.

October.

Spilogaster quadriseta, n. sp.

Male and female: Gray; thorax with two indistinct brown vittæ; second and third segments of abdomen each with two brown spots, and the fourth segment with a median, oval spot; legs black. Head silvery pollinose; eyes of male contiguous, frontal vitta velvety black, with four bristles on each side; frontal vitta of female broad, emarginated above by the gray frontal triangle, with five frontal, one strong inner vertical and one outer vertical bristle present, the lowest frontal is stronger than the others and more porrect; ocellar bristles strong and divergent; antennæ black, nearly as long as the face, arista long plumose; sides of face and upper part of cheeks bare; mouth-parts black. Thorax with four rows of dorsocentrals, each with two presutural and three postsutural bristles; two humerals, two notopleurals, two supraalars, of which the hinder one is small, and one postalar bristle present; prescutellar bristles very small; seven mesopleural, of which one is situated in upper anterior angle of the sclerite, and four sternopleural bristles present, two of the latter are situated low down; scutellum with a pair of strong, decussating apicals, a pair of weak subapicals, and a pair of strong basal bristles. Second, third and fourth abdominal segments with marginals, and third and fourth with discal bristles. Wings hyaline, veins light brown, costal spine present. Halteres yellow. Length, 5 mm.

One male and nine females; May, June, and October.

Spilogaster latifrons, n. sp.

Male: Gray; thorax with two brown lines anteriorly; abdomen with first segment largely, and posterior border of remaining segments, yellow; second and third segments brown, bimaculate. Head silvery pollinose; front with curved sides, slightly broader, at a point half-way between antennæ and ocelli, than ocellar tubercle, with three decussating frontal bristles above the antennæ, lowest pair strongest and porrect, others directed slightly backward, ocellar bristles large, pointing forward; antennæ black, nearly as long as the face, arista long, sparsely plumose; vibrissæ large; sides of face and upper part of cheeks bare; palpi black, proboscis short, yellowish at tip. Thorax with four rows of dorsocentrals, each containing two presutural bristles, the two middle rows three, and the two outer rows two postsutural bristles; two humerals, two notopleurals, two supraalars, the hind one very small, and one postalar bristle present; the pair of prescutellar bristles are very small and close together; of the mesopleural bristles two in upper part of row and one in lower part are strong, others weak; three sternopleurals, the middle one situated low down; scutellum with an apical pair of strong, decussating bristles, a pair of weak subapicals, and a pair of strong basals. Abdominal segments with a row of marginals, those of the third and fourth segments strongest, the third and fourth also with a row of discals; hypopygium small, largely concealed. Legs black, coxæ, tips of femora, and tibiæ yellow, femora gray dusted. Wings hyaline, veins yellowish, a distinct costal spine present. Halteres yellow. Length, 4.5 mm.

Female: Same as male, except there are five frontal bristles, the lowest pair being largest and more porrect, a large inner and smaller outer vertical bristle present; the gray frontal triangle reaching nearly to the antennæ; the coxæ and the front femora largely, and upper surface of tip of middle and hind femora black. Length, 5.5 mm.

Four specimens; April and May. The specific name is given in reference to the rather broad front of the male.

CARICEA.

(Desvoidy, Myod., p. 530; 1830.)

Caricea sexnotata, n. sp.

Female: Head black, occiput gray pollinose, front, face, and cheeks uniformly yellowish-gray pollinose, four frontal bristles present, inner verticals large, outer small, antennæ yellow, arista short plumose, proboscis black, palpi yellow. Thorax black, gray pollinose, with two rows of dorsocentrals, each with one in front of and three behind the suture, two humeral, two posthumeral, one just internal to the posthumerals, one supraalar and one postalar bristle present, prescutellars absent; three mesopleural and three sternopleural bristles, one of the latter low down; scutellum with an apical and a basal pair of bristles; halteres yellow. Legs uniformly yellow. Front two segments of abdomen yellow, second with two brown spots, third and fourth segments black, covered with gray pollen, and each with two velvety black spots. Wings hyaline, veins semitranslucent. Length, 3 mm.

Two specimens; May.

Caricea multimaculata, n. sp.

Male and female: Black, gray pollinose. Antennæ rather long for this genus, arista short plumose. Four frontals, inner vertical present, outer vertical absent, ocellar bristles small; proboscis sometimes with a yellowish cast, palpi linear. Two rows of dorsocentrals, each with one in front of and three behind the suture, two humeral, two posthumeral, one above posthumerals, one supraalar, and one postalar bristle, prescutellar bristles absent; four mesopleurals and three sternopleurals, one of the latter situated low down; scutellum with an apical and a basal pair of bristles; halteres yellow. Each abdominal segment, besides having a linear, central spot, with a larger, brown spot on each side; third and fourth segments with discal macrochætæ. Coxæ and femora black, tibiæ yellow, tarsi fuscous. Wings hyaline. Length, 3.3 mm.

Ten specimens; May and June.

Caricea flavipes, n. sp.

Female: Very close to *multimaculata*, agreeing in size, color, and chætotaxy; the markings of the abdomen are the same, but not so distinct. The legs are wholly yellow.

Five specimens; April.

CHORTOPHILA.

(Macquart. Hist. Nat. Dipt., II, 323; 1825.)

Chortophila linearis, n. sp.

Male and female: Black, uniformly covered with yellowish-gray pollen. Frontal vitta in male velvety black, except just above antennæ where it is reddish; in the female it is largely reddish yellow, and bears a pair of bristles just below the vertical triangle; three frontals in male, five in female, inner and outer verticals small in male, large in female. Antennæ black, first two joints of a reddish cast, arista short plumose. Face of male more silvery pollinose than in the female. Oral margin, palpi and apex of proboscis with a brownish cast, palpi linear. Mesonotum with four rows of dorsocentrals, middle rows with two bristles in front of and three behind the suture, outer rows with two in front of and two behind the suture; two humerals, two posthumerals, one supraalar and one postalar bristle present; prescutellar bristles small; four mesopleurals and two sternopleurals, the male with three sternopleurals; apicals and basals of scutellum strong, preapical pair small. Abdomen with marginal macrochætæ, those of the male stronger than those of the female, second, third and fourth segments of the male with a median linear spot. Wings hyaline, with a faint fuscous tinge; costa with a strong spine at tip of auxiliary vein. Halteres yellow. Legs black, knees in the male and the tibiæ in the female with a yellowish cast. Length, 4.3 mm.

Numerous specimens; May and June.

HYDROPHORIA.

(Desvoidy, Myod., 503; 1830.)

Hydrophoria tarsata, n. sp.

Male: Head and members yellow, occiput black and covered with a thin coat of gray pollen; two pair of frontal bristles just above the antennæ. Thorax subshining black, with a thin coat of gray pollen; humeri faint yellowish in ground color, not perceptible in the perfect specimens; two rows of dorsocentrals, each with two bristles in front of and three behind the suture, two humerals, two posthumerals, one supraalar, and one postalar, the prescutellar bristles mark the termination of two rows of small bristles on dorsum of mesonotum; four mesopleural and four sternopleural bristles present, two of the latter situated low down; scutellum with an apical, a preapical, and a basal pair of bristles; halteres yellow. Abdomen yellow, a triangular spot on posterior margin of second, and the third and fourth segments largely, black, in certain lights all segments silvery pollinose on posterior border. Legs yellow, tarsi black, pulvilli yellow. Wings yellowish. Length, 5 mm.

Two specimens; April.

CŒNOSIA.

(Meigen, Syst. Beschr., V, 210; 1826.)

Cœnosia valida, n. sp.

Male and female: Head yellow, occiput black, with gray pollen, frontal vitta velvety brown, yellow on lower third; first two antennal joints yellow, third black, reaching almost to the oral margin, arista black, bare; proboscis short, black, palpi yellow; five frontal bristles, an inner and an outer vertical bristle present, ocellar bristles directed forward. Thorax black, with gray pollen, humeri and lower part of pleuræ yellowish; bristles on mesonotum short and not easily differentiated from the bristly hairs; I can definitely see three humeral, two posthumeral, one supraalar, one postalar, one dorsocentral on hind border, and a pair of small prescutellar bristles; there are three mesopleural and three sternopleurals, one of the latter situated low down; besides an apical and a basal pair, there is a pair of small preapical bristles on the scutellum. Abdomen yellow, in the male the third and fourth segments, and in the female the fourth, bimaculate. Legs yellow, in the male the apical fourth, and in the female the apical two-thirds, of the front femora black, the front tibiæ, except the basal fourth, and all tarsi blackish. Wings hyaline, veins semitranslucent. Halteres yellow. Length: Male, 3 mm.; female, 4.5 mm.

Ten specimens; February and April.

Cœnosia lineata, n. sp.

Female: Head black, gray pollinose, sides of front shining, frontal vitta opaque black, five frontal bristles, and the usual inner and outer verticals, ocellar bristles small; antennæ black, reaching nearly to the oral margin, arista bare; face and cheeks yellow; proboscis and palpi black, the former longer than the height of head. Thorax black, gray pollinose, with a distinct brownish median vitta; chætotaxy same as in *valida*. Abdomen yellow. Front legs black, front coxæ, base of front femora, and middle and hind legs wholly, yellow. Wings hyaline, veins semitranslucent. Halteres yellow. Length, 4 mm.

Two specimens; date not recorded.

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12,955

VOL. VII. No. 3.

BULLETIN
OF THE
UNIVERSITY OF KANSAS.

PUBLISHED BIMONTHLY BY THE UNIVERSITY OF KANSAS,
AT LAWRENCE.

SCIENCE BULLETIN,
Vol. III, Nos. 7, 8, 9, and 10.

(Continuation of Kansas University Quarterly.)

JUNE 1906.

LAWRENCE, KANSAS.
Entered at the Post-office as Second-class Matter.

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THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 7—April, 1906.
(Whole Series, Vol. XIII, No. 7.)

CONTENTS:

RESPIRATORY RESPONSES IN THE GRASSHOPPER TO VARIATIONS IN PRESSURE, ... *L. W. Roller.*

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KAN.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 7. APRIL, 1906. WHOLE SERIES, VOL. XIII, NO. 7.

RESPIRATORY RESPONSES IN THE GRASSHOPPER TO VARIATIONS IN PRESSURE.

BY L. W. ROLLER.

From the Physiological Laboratory of the University of Kansas.

With plate XLI.

THE existence of a respiratory center in vertebrates evidently gave rise to the idea of a coordinating center of respiration in insects located in the head. Faivre[1] assumed that the subœsophageal ganglion in *Dytiscus* has a coordinating influence on the respiratory movements, because, when the subœsophageal ganglion, or brain, is destroyed, the respiration is not interrupted, whereas, lesion to the subœsophageal ganglion causes cessation of respiratory movements. Hyde[2] found that after the extirpation of the subœsophageal ganglion in *Limulus* respiration ceased, but when the shock effect had passed off respiratory movements gradually began again, and that the abdominal ganglia are centers for the rhythmical respiratory movements. This fact was also demonstrated by Ewing,[3] who, while working in this laboratory, observed that the abdomen of the grasshopper may be divided into several parts, each of which executes mechanical respiratory movements. These facts prove the erroneousness of Faivre's assertions.

The effects of changes in barometric pressure upon the respiratory movements have been observed upon both lower and higher forms than the grasshopper, none of which, however, had the peculiar properties that make this animal so valuable for experiments on respiration. Since respiratory movements continue in the grasshopper, even after removal of the viscera and trachea, it is possible to study the effects of pressure acting directly on the nervous system, as well as upon the intact animal.

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[1] Faivre: Comptes rendus de l'Academie des Sciences, 1860, vol. LI, p. 38.

[2] Hyde, Ida H.: Journal of Morphology, 1894, vol. IX, No. 3, p. 431.

[3] Ewing, H. Z.: Kansas University Science Bulletin, 1904, vol. I, No. 2, p. 306.

The apparatus employed for securing high atmospheric pressure consisted of a pressure pump run by a dynamo, and an iron cylinder with tubular connections as illustrated on plate XLI. The cylinder which contained the animals was three feet long and six inches in diameter, painted white inside, and supplied with two valves. One valve was connected through a pressure gauge to the pressure pump, and the other served for the exit of the air. The end lids of the cylinder contained heavy glass windows through which light was reflected into the cylinder. The lids were closed air-tight by iron caps that were secured in place by rivets, and all joints were packed with rubber washers. An open glass tube that contained potassium hydroxide was placed in the cylinder to absorb the carbon dioxide. When studying the effects of low pressure, the grasshoppers were placed in long test-tubes that were connected air-tight to a Sprengle pump that gradually exhausted the contained air.

The material employed in the experiments consisted of different species of both spring and autumn, adult and immature grasshoppers, decapitated, and abdominal parts both with and without the viscera and tracheal tubes. In the latter the nerves were directly exposed to the pressure.

According to Paul Bert,[4] the effect arising from variations in barometric pressure on all living organisms is entirely the result of the tension at which the oxygen is maintained under various atmospheres; and he has called attention to the fact that, at a certain pressure, oxygen is not only not beneficial, but, on the contrary, remarkably toxic. By exposing an animal to four atmospheres of oxygen, for instance, the same effect is produced as that caused by increasing the barometric pressure of the air twenty times. Bert found that in small birds exposed to three and one-half atmospheres of oxygen, that is, seventeen and one-half barometric pressure of air, convulsions appeared in about five minutes, and if exposed to the pressure longer, and then removed to atmospheric pressure, the tetanic spasms continued until death. If the tension was raised at once beyond this, the birds died at once. In a dog, the toxic effect lasted twenty-four hours after it was removed from the high oxygen pressure. He concluded that oxygen, at a certain tension, became toxic to nerve tissue.

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[4] Bert, Paul E.: Comptes rendus de l'Academie des Sciences, 1873, vol. LXXVI, p. 443.

According to Verworn,[5] pure oxygen at a pressure of more than three atmospheres, or fifteen atmospheres of air, is fatal to homothermal animals, while, with ordinary air, the same results appear at fifteen to twenty atmospheres. The animals die of asphyxia and convulsions, exactly as when oxygen is deficient and the production of carbonic acid is increased. Muller[6] found that at twenty atmospheres germination and putrefaction are arrested. Smith[7] discovered that, when birds were exposed twenty-four hours to an oxygen tension of 180 per cent., or nine atmospheres of air, the lungs become inflamed and that the time of onset of the inflammation is earlier the higher the tension. Oxygen which, at the tension of the atmosphere, stimulates the lung cells to active absorption, at higher tension acts as an irritant, is toxic, and produces inflammation. He also ascertained that there were two phases of oxygen effects, one consisting in a slowly developing inflammatory state, seen most prominently in the congestion of the lung tissue; the other a rapidly developing effect on the nervous system. A tension of twenty atmospheres, for instance, gives rise to the inflammatory effect in mice in five hours; and in birds, under the same tension, in twelve minutes, to convulsions, due to tetanic effects on the nervous system. This question is of practical importance in connection with caisson and submarine work and the therapeutical use of oxygen.

According to records of men in caissons, engaged in severe work under an oxygen tension of about two atmospheres, often some endure the exposure without severe effect, while in others it has an effect on the lungs. They are occasionally in as high as four to five atmospheres of air pressure, and are most liable to dangerous effects while passing from the caissons to the external air. Sudden variations of pressure are far more dangerous than gradual alterations. There is at this time danger of accident due to embolism, by disengagement of the gases within the blood. When the changes of pressure are gradually undergone the intrapulmonary and extrathoracic pressures fall or rise together, and thus the circulatory mechanism remains unaffected. In the *post-mortem* records of cases in which death ensued from the effects of caisson disease, according to Smith, the congestion of the viscera, including the lungs, has been noted, and tends to show that the effects of high oxygen tension are not directly limited to the nervous system, as Bert believed.

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[5] Verworn: Sitzungsbericht der koniglichen Preussischen Akademie der Wissenschaften zu Berlin, 1896, p. 1243.

[6] Muller, W.: Sitzungsbericht der koniglichen Akademie der Wissenschaften, Wien, 1858, Bd. 33, p. 99.

In the grasshopper we possess an animal that continues respiratory movements when the structures that are homologous to the lungs of higher forms are removed, so that the effect of the high tension directly on the nervous system can be ascertained. In the grasshopper we have, therefore, most favorable material with which to determine the question whether it is the altered state of the blood, the lowered absorption of the congested lung tissue, the indirect tension through the blood, or direct influence on the nervous system, that produces convulsions in these animals under high atmospheric pressure.

This work was undertaken at the suggestion and under the guidance of Prof. Ida H. Hyde, to whom I am under great obligations for kind and valuable aid.

The Influence on Respiratory Movements in Normal and Decapitated Immature Grasshoppers (Nymphs) Subjected to a High Pressure, that Alternated with Atmospheric Pressure.

Table I gives the average results obtained from these experiments. It was seen that normal and decapitated immature grasshoppers placed under a pressure of about 200 pounds, or thirteen atmospheres, continue their respiratory movements at a reduced rate and force for about three days ; after that all movements cease. If the animals are now transferred to

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7. Smith, J. Lorain: Journal of Physiology, 1899, vol. XXIV, p. 34.

fresh air and atmospheric pressure for about fourteen hours, the respiratory movements again appear. It was surprising to see that in a few hours the heart was beating forcibly, long before there were any indications of life in any other parts of the body. They had been exposed twenty-four hours to atmospheric air and then were again subjected to 250 pounds pressure, but the respiration now ceased in about eighteen hours, and revived in about half an hour, when removed from the high pressure to that of atmospheric air. For the third time they were exposed to about 250 pounds pressure; the decapitated stopped breathing at once, the normal within twenty-four hours. The latter revived in half an hour in fresh air, and then, for the fourth time, exposed to the high pressure, under which respiratory movements soon ceased and did not return in fresh air.

It had been ascertained that normal grasshoppers can live about four days in the laboratory without food. In these experiments, the grasshoppers lived eight days without food. The respiratory movements continued half of that time under an average tension of 200 pounds, or thirteen atmospheres.

TABLE I.

TIME.	Pressure, pounds.	Respiration.	
		Normal.	Decapitated.
Feb. 13, 8:30 A. M..	200	Breathing.	Breathing.
“ 14, 8:30 “ ..	140	“	“
“ 15, 8:30 “ ..	100	“	“
“ 15, 9:00 “ ..	200	“	“
“ 16, 9:00 “ ..	200	Stopped.	Stopped.
“ 16, 5:00 P. M..	Removed to fresh air.	“	“
“ 17, 7:30 A. M..	....	Breathing.	Breathing.
“ 17, 2:00 P. M..	250	“	“
“ 18, 8:00 A. M..	250	Stopped.	Stopped.
“ 18, 9:00 “ ..	Removed to air.	“	“
“ 19, 9:30 “ ..	In air.	Breathing.	Breathing.
“ 19, 10:00 “ ..	225	“	“
“ 19, 4:00 P. M..	275	“	Stopped.
“ 20, 10:00 A. M..	250	Stopped.	“
“ 20, 11:30 “ ..	In fresh air.	“	“
“ 21, 9:30 “ ..	“	Breathing.	Not revived.
“ 21, 11:30 “ ..	250	“	Dead.
“ 22, 9:00 “ ..	250	Stopped.	....
“ 22, 9:10 “ ..	In fresh air.	Did not revive.	....

The Effect of Gradually Increased Pressures.

Normal, decapitated and deviscerated grasshoppers were first subjected to a pressure of 100 pounds. The pressure was daily gradually increased until it reached 275 pounds.

Table II shows the pressure in pounds and time during which the animals were subjected to it.

TABLE II.

TIME.	Pressure, pounds.	Despiration.	
		Normal.	Deviscerated.
March 21, 5:30 P. M..	100	Breathing.	Breathing.
" 22, 3:30 " ..	150	"	"
" 23, 5:30 " ..	200	"	"
" 24, 9:30 A. M..	275	"	Stopped.
" 25, 9:00 " ..	Removed to air; did not recover.	Stopped; did not recover.	Not revived.

In animals that had the viscera and tracheal tubes removed, the respiration continued after an exposure to gradually increased pressure for about sixty hours, while the normal animals breathed about twelve hours longer and did not again revive in fresh air. The animals exhibited no spasms before they were removed from the pressure, and *post-mortems* showed that the viscera and tracheal tubes had been removed.

TABLE III.

TIME.	Pressure, pounds.	Respiration.		
		Normal.	Deviscerated.	Decapitated.
Mar. 14, 5:30 P. M.	275	Breathing.	Breathing.	Breathing.
" 15, 8:30 A. M.	255	"	"	"
" 15, 8:40 "	Taken out to observe.	"	Spasms.	"
" 15, 9:00 "	275	"	"	"
" 16, 5:30 P. M.	Taken out.	Stopped.	Stopped.	Stopped.
" 17, 9:00 A. M.	In air.	Not revived.	Not revived.	Not revived.

Table III shows the mean results of experiments pursued with normal, decapitated and deviscerated immature forms suddenly exposed to about 275 pounds pressure, or fourteen atmospheres. After an exposure for fifteen hours to 275 pounds pressure the animals were removed to that of atmospheric. The deviscerated that had the abdominal nerve cord directly exposed to the pressure suddenly displayed spasmodic movements of all the appendages; one spasm followed the other in rapid succession. The normal and decapitated did not have spasms, but their respiratory movements were abnormally rapid. They were immediately replaced under 275 pounds pressure and kept there for about twenty-four hours longer. When observed at the end of that time it was noticed that the respiration stopped, and did not return in fresh air and atmospheric pressure.

While the grasshoppers were under the pressure they did not have spasms; they appeared when the animals were very gradually removed from the pressure. It was also noticed that the first effect of the high pressure was an acceleration of the respiratory movements and then the rhythm decreased very much in force and rate.

In another related series of experiments, immature February forms appeared lifeless at the end of twenty-four hours' exposure to 275 pounds pressure, and when removed to atmospheric air fluid escaped from their mouths, while the abdomens in the normal animals became greatly inflated, then gradually assumed their normal dimensions again. During an exposure of two hours to atmospheric pressure the heart and respiratory movements reappeared. The animals were again subjected to 275 pounds tension for about thirty hours, when respiration had ceased and was not again established under atmospheric pressure. November and December forms die in less than two days under a pressure of 275 pounds.

Table IV shows the effect of sudden high pressure on normal and deviscerated mature grasshoppers.

TABLE IV.

TIME.	Pressure, pounds.	Respiration.	
		Normal.	Deviscerated.
May 13, 3:15 P. M.	250	Breathing.	Breathing.
" 13, 4:15 "	Taken out to observe.	Sluggish.	Spasms.
" 13, 5:10 "	250	....	....
" 14, 8:00 A. M.	Taken out to observe.	No spasms.	Spasms.
" 14, 11:00 "	250	....	....
" 14, 5:15 P. M.	Removed.	Moves appendages spasmodically.	Stopped.
" 14, 8:25 "	In air.	....	Revived with spasms.

It was found that, when the grasshoppers were removed to atmospheric pressure after they had been exposed for one hour to a pressure of 250 pounds, the normal were very sluggish and the deviscerated had severe spasms that lasted almost seven hours. The normal and other deviscerated were now placed for twelve hours under a pressure of 250 pounds, and when removed from the pressure the normal insects displayed spasmodic tetanic movements of the appendages, and the deviscerated had severe spasms. When, during two hours under atmospheric pressure, they had recovered somewhat from the tetanic spasmodic state, they were for a third time subjected to 250 pounds pressure. The normal and deviscerated, when removed from this at the end of six hours, had ceased respiratory and other activity; but the normal revived in one hour, while the deviscerated in three hours under atmospheric pressure, and displayed spasmodic movements of the appendages. Other experiments were pursued with normal and deviscerated mature grasshoppers subjected to a very high pressure for varying periods of time, with the following results: It was ascertained that, when both normal and deviscerated May grasshoppers were removed to atmospheric pressure from ten minutes' exposure to 280 pounds pressure, the deviscerated had slight spasms, the normal not. On the other hand, November grasshoppers did not exhibit spasms when subjected ten minutes or even three-fourths of an hour to the high pressure of 275 pounds, but they all displayed a sluggish, paralyzed condition at the end of that time. An exposure to the pressure for one hour showed that the animals moved their appendages with difficulty, and that after half an hour in atmospheric pressure the deviscerated had spasms, while the intact animals recovered their normal activity.

Effect of Gradually Lowering the Pressure upon Respiratory Movements in the Grasshopper.

The reduced pressure was obtained by means of a Sprengle pump, to which was joined a glass tube containing the grasshoppers. As soon as the pressure fell the animals became restless and moved about in the tube. At first a noticeable expansion of the abdomen occurred, due to decreased external pressure; but the normal dimensions were again regained when they were subjected some time to a vacuum. The respiratory movements ceased at the end of ten minutes, and in some experiments before the end of six minutes, while the pressure was being gradually decreased and a vacuum not yet attained.

In the last stages of respiratory activity there was a strong launching forward, as if gasping for air, and the appendages assumed a flexed or semiflexed position, in which they remained. The heart was found beating after hours of exposure to a vacuum, though respiration had stopped.

It was seen from this series of experiments that November grasshoppers cease respiratory movements as a vacuum is produced, and that if they are kept in a vacuum seven hours and then exposed to atmospheric air they will recover; but an exposure of eight hours to the vacuum proves fatal.

CONCLUSIONS.

It was believed by Paul Bert and Smith that the injurious effects on lung tissue and the nervous system, due to high tensions of atmospheric pressure, are referable to the toxic influence of oxygen at high pressure, which then acts as an irritant, producing inflammation or pneumonia, and convulsions. Smith showed, furthermore, that if the pressure is gradually raised, the onset of inflammation and convulsions is greatly postponed, and later he proved that it was not alone the toxicity of the oxygen at high tension that was responsible for the pathological conditions, but that the high atmospheric pressure itself was injurious to the lung tissue and nerve-cells. Related to the experiments on the influence of high atmospheric tension is the question of caisson disease. *Post-mortem* records of cases dying from this disease showed congestion of the lungs. The workers are often under a tension of 4 to 5 atmospheres. It has been believed that this disease is produced rather by the sudden change from the high to low pressure, but it is admitted that the risk of accident to workers is proportional to the time of exposure to high pressure.

The results obtained from a study of the influence of high atmospheric pressure on the respiration in grasshoppers strengthens those obtained by Smith on mammals and birds. He showed that convulsions occurred in birds in three minutes if exposed to oxygen of 280 per cent. of atmospheric pressure or fourteen atmospheres, and in mice in twelve minutes, under an oxygen tension of 400 per cent. atmospheric pressure or twenty atmospheres.

Smith's final experiments led him to conclude that the convulsions were the result of high tension. For testing this question, deviscerated grasshoppers proved ideal material, since most of the trachea and blood were removed, leaving the active respiratory muscles and their centers directly exposed to the pressure.

It was seen from the foregoing experiments that the deviscerated grasshoppers displayed slight convulsions when removed to ordinary atmospheric pressure, often they had been subjected suddenly to a pressure of 280 pounds, or fourteen atmospheres. Moreover, that tetanic convulsions that lasted for several hours appeared if they were kept under that high pressure one hour. Under the same conditions, the normal animals, which had exaggerated respiratory movements when first subjected to the pressure, and later very faint ones, when exposed to ordinary air, gradually increased the sluggish respiratory movements to exaggerated ones, that later became quite normal again. Furthermore, it was shown that the normal and deviscerated both displayed convulsions if kept under this high pressure twelve hours, though they were very gradually removed from high to ordinary pressure. They ceased all respiratory activity that could not be revived if kept under 280 pounds pressure for two days. Moreover, if the pressure was gradually raised to 280 pounds, or fourteen atmospheres, convulsions failed to appear either in the deviscerated or normal grasshoppers kept under these tensions as long as three days, or until they died.

It was interesting to learn that the grasshoppers lived longer —in fact, much longer—than in ordinary air pressure, without food. When high tensions of 200 pounds or ten atmospheres alternated with that of ordinary air, they were in a more or less comatose condition and metabolism was reduced to a minimum under the high pressure. Moreover, this pressure was not as injurious to the tissue as a pressure of 280 pounds, under which they did not live more than two days, probably because that pressure produced inflammatory conditions in the viscera and tissue corresponding to that of the lungs of higher animals.

It would seem, therefore, that sudden high pressure acting for a few minutes or a few hours, depending upon the maturity of the animals, the time of the year, and the condition of the grasshopper, whether moribund or not, acts as a toxic substance, somewhat like strychnine, directly upon the nervous system, producing convulsions that are of long duration. Moreover, when the pressure acts for one or several days, the tissue of the normal insect is so affected that if it has not died from the changed condition it has severe convulsions when it is removed from the pressure. The spasmodic tetanic movements of the appendages may appear within a few minutes and often after half an hour's exposure to atmospheric pressure and last for several hours. They may entirely recover from the spasms, or the respiratory movements may have ceased when the animals are taken from the pressure machine and some time later again reappear in air. If that is the case the convulsive movements may usher in respiratory activity.

THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 8—April, 1906.
(Whole Series, Vol. XIII, No. 8.)

CONTENTS:

KANSAS APHIDIDÆ, WITH CATALOGUE OF NORTH AMERICAN APHIDIDÆ, AND WITH HOST-PLANT AND PLANT-HOST LIST, PART II,
Charles Emerson Sanborn.

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KAN.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, NO. 8. APRIL, 1906. { WHOLE SERIES, VOL. XIII, NO 8.

KANSAS APHIDIDÆ.

WITH CATALOGUE OF NORTH AMERICAN APHIDIDÆ AND HOST-PLANT AND PLANT-HOST LIST, PART II.

BY CHARLES EMERSON SANBORN.

ERRATA TO PART I.

(Vol. III, pp. 1–82.)

Page 8, line 4 from bottom, read *inferior* instead of "superior."

Pages 9 and 10, Color Key and Measure Key are now combined in Blank Key, which is inserted.

Page 13, foot-note 8, omit "genus" and "sp."

Page 14, insert, as line 1, Pulvius probosceus, n. g. and sp.

Page 17, *Hart* instead of "Hartig."

Page 18, *Pemphigus populitransversus* Riley instead of "burrowi."

Page 19, line 9, omit "honey-tubes and style are absent."

Page 27, after "limbs," in next to last paragraph, insert "of apple (Malus malus L.)"

Page 28, after "dogwood," in line 17, insert "(Cornus asperifolia Michx.)

Page 29, line 11, omit "i" in Colophia.

Page 29, *Burmeister* instead of "Bermeister."

Page 33, *Buckton* instead of "Buckston."

Page 34, Chaitophorus. Plate VII, fig. 43, n. sp.

Page 36, for "stevensis n. sp." read *populifolia Fitch.*

Page 37, in line 14, after "gall," omit remainder of sentence.

Page 37, read *new genus* instead of "Chaitophorus," in third line from bottom.

Page 54, under "Aphis brassicæ," line 9, omit remainder of sentence: "Total length," etc.

Page 62, third line from bottom, omit "Koch."

Page 67, third word is *basal;* and instead of "Nectarophora," eighteenth and nineteenth lines, read *Macrosiphum.*

Page 71, tenth line, for "Macrosiphum" read *new genus.*

Page 72, in third line: Mr. Theo. Pergande did not have sufficient material perhaps for identification. Since getting additional notes he thinks it may be a new genus. In line 7, for "anomalous" read *curious.* In line 17, after "could," insert "with exception of honey-tubes."

Page 73, line 3, read *is* instead of "seems to be."

Page 75, line 15, for "female" read *male.* Line 16, read *form* instead of "stem-mother."

Page 81, after first word in last paragraph, read *first segment* instead of "front joints."

Page 82, after first word in last paragraph read "migratory."

Plate II, figure 12, read *Gladobius* instead of "Melanoxanthus."

Plate IV, figures 25 and 26, ventral and dorsal view of Pulvius probosceus, n. g. and sp.

Plate VII, figure 47, read *populifolia* for "stevensis."

Plate XV, for "Macrosiphum" read *new genus.*

Plate XVIII, figure 88, manuscript is lost.

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PLANT-HOST LIST.

- Abies nigra Michx.
  - Chermes abietis L.
    - abieticolens Thos.
  - Lachnus abietis Fitch.
- Acalypha virginica L.
  - Aphis gossypii Glov.
- Acer dasycarpum Ehrh. (A. saccharinum L.)
  - Aphis quercifoliæ Walsh.
  - Drepanosiphum acerfolii Thos.
  - Lachnus longistigma Monell.
  - Pemphigus acerfolii Riley.
    - stamineus Hald.
- Acer pennsylvanicum L.
  - Chaitophorus aceris L.
- Acer platanoides Linn.
  - Chaitophorus sp. Felt.
- Acer saccarum Marsh.
  - Cladobius saliciti Harris.
  - Drepanosiphum acerfolii Thos.
  - Pemphigus aceris Monell.
- Acer sp.
  - Cladobius saliciti Harris.
- Acerates angustifolia Nutt.
  - Aphis asclepiadis Fitch.
- Achyrantes sp.
  - Myzus achyrantes Monell.
- Adianthum pedatum L.
  - Aphis adianthi Oestl.

Argrostis plumosa.
Tetraneura graminis Monell.
Agrostis vulgaris and A. alba L.
Macrosiphum avenæ F.
Aira cæspitosa L.
Tetraneura granimis Monell.
Alisma plantago-aquaticca L.
Rhopalosiphum nymphææ L.
Alnus rubra Bong.
Pemphigus tessalata Fitch.
Alnus sp.
Lachnus alnifoliæ Fitch.
Pemphigus alni Prov.
Alsine media L.
Aphis gossypii Glov.
Althea sp.
Aphis cucumeris Forbes.
malvae Walker.
Amarantus albus L.
Aphis sp. Weed.
Amarantus hybridus L.
Aphis maidi-radicis Forbes.
Amarantus retroflexus L.
Aphis gillettei Cowen.
Amarantus sp.
Aphis gossypii Glover.
Ambrosia psilostachya DC.
Macrosiphum ambrosiæ Thos.
Ambrosia trifida L.
Aphis maidis Fitch.
middletoni Thos.
Macrosiphum ambrosiæ Thos.
rudbeckiæ Fitch.
Tychea erigeronensis Thos.
Amelanchier anifolia Nutt.
Pemphigus anifoliæ Will.
Ammonia sp.
Rhopalosiphum dianthi Schr.
Ampelopsis quinquefolia.
Aphis setariæ Thos.
Andropogon furcatus Muhl.
Schizoneura corni F.
Apocynum androsæmifolium L.
Aphis apocyni Koch.
Apocynum cinnabium L.
Aphis apocyni Koch.
asclepiadis Fitch.
Lutescens Monell.
Apocynum sp.
Aphis asclepiadis Fitch.

- Aragallus lamberti Pursh.
  - Aphis medicaginis Koch.
- Archangelica atropurpurea L.
  - Siphocoryne archangelicæ Oestl.
- Arctostaphylos uva-ursi L.
  - Macrosiphum sp. Cowen.
- Artemisia absinthium L.
  - Macrosiphum absinthii L.
- Artemisia cana Pursh.
  - Aphis artemisicola Will.
    - canæ Will.
  - Macrosiphum artemisicola Will.
- Artemisia canadensis Michx.
  - Cryptosiphum canadensis Will.
- Artemisia frigida Willd.
  - Aphis frigidæ Oestl.
  - Macrosiphum frigidæ Oestl.
  - Cryptosiphum sp.
- Artemisia ludoviciana Nutt.
  - Cryptosiphum canadensis Will.
  - Macrosiphum ludoviciana Oestl.
- Artemisia tridentata Nutt.
  - Macrosiphum coweni Hunter, W. D.
- Artemisia vulgaris L.
  - Macrosiphum artemisiæ Thos.
- Asclepias syriaca L.
  - Aphis asclepiadis Fitch.
    - lutescens Monell.
- Callipterus asclepiadis Monell.
  - Macrosiphum asclepiadis Fitch.
- Asclepias incarnata L.
  - Aphis lutescens Monell.
- Asclepias obtusifolia Michx.
  - Callipterus asclepiadis Monell.
- Asclepias speciosa Torr.
  - Aphis asclepiadis Fitch.
  - Macrosiphum asclepiadis Fitch.
- Asparagus officinalis L.
  - Aphis gossypii Glov.
  - Myzus mahaleb Fonsc.
  - Rhopalosiphum dianthi Schrank.
- Aster sp.
  - Aphis middletonii Thos.
- Astragulus bisulcatus Hook.
  - Aphis medicaginis Koch.
- Atriplex hortensis L.
  - Aphis rumicis L.
- Beet.
  - Aphis atriplicis L.
    - cucumeris Forbes.
  - Macrosiphum pisi Kalt.

- Begonia sp.
  - Aphis gossypii Glov.
- Berberis vulgaris L.
  - Rhopalosiphum berberidis Kalt.
- Betula papyracera Marsh.
  - Callipterus betulæcolens Fitch.
  - Hormaphis papyraceæ Oestl.
- Betula sp.
  - Pemphigus imbricator Fitch.
    - tesselata Fitch.
- Bidens frondosa L.
  - Aphis frondosæ Oestl.
  - Rhopalosiphum nymphææ L.
- Bidens lævis L.
  - Macrosiphum calendula Monell.
    - chrysanthemi Oestl.
    - rudbeckiæ Fitch.
- Brassica arvensis L.
  - Aphis brassicæ L.
- Brassica oleracæ L.
  - Aphis brassica L.
- Broccoli.
  - Aphis brassicæ L.
- Bromus secalinus L.
  - Macrosiphum avenæ F.
- Broom corn.
  - Aphis maidis Fitch.
- Brussels sprouts.
  - Aphis brassicæ L.
- Caladium esculentum.
  - Aphis malvæ Walker.
  - Rhopalosiphum dianthi Schrank.
- Calendula micrantha.
  - Aphis calendulicola Monell.
  - Macrosiphum calendulicola Monell.
    - calendulella Monell.
- Calla indica.
  - Macrosiphum circumflexa Buckt.
  - Rhopalosiphum dianthi Schrank.
- Cannabis sativa L.
  - Aphis sativa Will.
- Capsella bursa-pastoris L.
  - Aphis brassicæ L.
    - gossypii Glover.
    - rumicis L.
  - Forda occidentalis Hart.
  - Macrosiphum pisi Kalt.
  - Schizoneura corni F.
- Carnation.
  - Phorodon cyanoglossi Will.
  - Rhopalosiphum dianthi Schrank.

- Caragana arborescens Lam.
  - Aphis medicaginis Koch.
- Carya alba L.
  - Monellia caryella Fitch.
  - Phylloxera caryæ Fitch.
    - caryæcissa Riley.
    - caryæfallax Riley.
    - caryæfoliæ Fitch.
    - caryæglobuli Walsh.
    - caryægummosa Riley.
    - caryæsepta Shimer.
    - caryævellana Riley.
    - caryævenæ Fitch.
    - conica Shimer.
    - depressa Shimer.
- Carya amara Nutt.
  - Monellia caryella Fitch.
  - Phylloxera caryæcaulis Fitch.
    - forcata Shimer.
    - minimum Shimer.
    - spinosa Shimer.
- Carya glabra Will.
  - Lachnus caryæ Harris.
  - Phylloxera caryæcaulis Fitch.
    - caryæglobuli Walsh.
    - caryæren Riley.
    - caryæsemen Walsh.
    - gibbosa Shimer.
- Carya olivæformis Nutt.
  - Callipterus sp. Monell.
  - Phylloxera sp. Riley-Howard.
- Carya minima (see C. amara Nutt.)
- Carya sp.
  - Callipterus caryæ Monell.
  - Phylloxera caryæglobosa Shimer.
    - depressa Shimer.
    - forcata Shimer.
  - Schizoneura caryæ Fitch.
- Castanea dentata Marsh. (C. sativa americana.)
  - Callipterus castanæ Fitch.
  - Phylloxera castaneæ Hald.
    - sp.
  - Catalpa.
  - Aphis gossypii Glover.
  - Chaitophorus negundinis Thos.
  - Phorodon cyanoglossi Will.
- Cauliflower.
  - Aphis brassicæ L.
- Celastrus scandens L.
  - Macrosiphum sp. Lint.

Celery.
    Aphis pastinaceæ Koch.
Cephalanthus occidentalis L.
    Aphis cephalanthi Thos.
Cerasus serotina L.
    Aphis cerasicolens Fitch.
        cerasifoliæ Fitch.
Chenopodiaceæ sp.
    Aphis rumicis L.
        atriplicis L.
Chenopodium album L.
    Aphis chenopodii Cowen.
        gossypii Glover.
        rumicis L.
Chenopodium anthelminthicum L.
    Aphis gossypii Glover.
Chenopodium sp.
    Aphis rumicis L.
Cherry.
    Aphis cerasicolens Fitch.
        cerasifoliæ Fitch.
    Myzus cerasi F.
        persicæ Sulz.
Chrysanthemum sp.
    Aphis chrysanthemicola Will.
    Macrosiphum chrysanthemicolens Will.
Cichorium intybus L.
    Tychea erigeronsis Thos.
Cicuta maculata L.
    Macrosiphum sp. Ost.-S.
Circium altissimum Willd.
    Aphis carduella Walsh.
Circium arvenæ Hoffm.
    Macrosiphum rudbeckiæ Fitch.
Circium lanceolatum Hoffm.
    Aphis cardui L.
Citrus aurantium L.
    Aphis gossypii Glov.
    Macrosiphum citrifolii Ashm.
Citrus sp.
    Aphis citri Ashm.
Cnicus sp.
    Aphis cardui L.
        carduella Walsh.
        eneci Will.
    Macrosiphum rudbeckiæ Fitch.
Convolvulus sp.
    Aphis gossypii Glover.
Coreopsis aristosa Michx.
    Aphis coreopsidis Thos.

- Corn.
  - Aphis maidis Fitch.
    - maidi-radicis Forbes.
  - Chaitophorus flavus Forbes.
  - Forda occidentalis Hart.
  - Myzus achyrantes Monell.
  - Rhopalosiphum dianthi Schrank.
  - Trama erigeronensis Thos.
- Cornus amonum Mill.
  - Schizoneura corni F.
- Cornus asperifolia Michx.
  - Schizoneura corni F.
- Cornus candidissima Marsh.
  - Aphis cornifoliæ Walsh.
    - maculata Oestl.
  - Schizoneura corni. F.
- Cornus florida L.
  - Aphis cornifoliæ Fitch.
- Cornus mas L.
  - Aphis gossypii Glover.
- Cornus paniculata (see candidissima).
- Cornus sanginea L.
  - Schizoneura corni F.
- Cornus sericea (see C. amonum Mill.)
- Cornus stolanifera Michx.
  - Aphis carnifoliæ Walsh.
  - Schizoneura corni F.
    - cornicola Walsh.
- Cornus sp.
  - Aphis maculata Oestl.
  - Schizoneura corni F.
- Corydalis aurea Willd.
  - Macrosiphum corydalis Oestl.
- Cratægus coccinea L.
  - Aphis cratægilfoliæ Fitch.
    - marutæ Oestl.
  - Macrosiphum cratægi Monell.
- Cratægus punctata Jacq.
  - Aphis cratægilfoliæ Fitch.
  - Schizoneura crataegi Oestl.
- Cratægus tomentosus L.
  - Aphis cratægilfolæ Fitch.
  - Schizoneura cratægi Oestl.
- Crocus sp.
  - Rhopalosiphum dianthi Schrank.
- Cucumis sativus L.
  - Aphis cucumeris Forbes.
- Cuphea (see Parsonsia).
- Currant.
  - Myzus ribis L.

Cyanoglossum sp.
    Phorodon cyanoglossi Will.
Cyranthus annuns.
    Rhopalosiphum dianthi Schrank.
Dactylis glomerata.
    Macrosiphum avenæ Fabr.
Datura stramonium L.
    Aphis gossypii Glover.
Deschampsia cæspitosa L.
    Tetraneura graminis Thos.
Desmodium canascens L.
    Macrosiphum desmodi Will.
Diodia teres Walt.
    Aphis gossypii Glover.
Diospyros virginiana L.
    Aphis diospyris Thos.
Elusne indica L.
    Aphis setaria Thos.
    Rhizobius elusinis Thos.
Elymus canadensis L.
    Callipterus (Myzocallis) sp. Oestl.
Epilobium spicatum Lam.
    Macrosiphum sp. Cowen.
Epilobium sp.
    Macrosiphum epilobii Pergande.
Eragrostis pectinacea Michx.
    Schizoneura corni F.
Eragrostis Prushii Schrad.
    Colopha eragrostidis Midd.
Eragrostis frankii Steud.
    Colopha eragrostidis Midd.
Eragrostis major Hast.
    Schizoneura corni F.
Eragrostis sp.
    Schizoneura corni F.
Erigeron altatum.
    Aphis erigeroni Cowen.
Erigeron canadensis L.
    Aphis maidi-radicis Forbes.
        middletoni Thos.
    Macrosiphum erigeronensis Thos.
Erigeron ramosus Nutt.
    Aphis middletoni Thos.
Erigeron umbellatum.
    Aphis erigeroni Cowen.
Euonymus europæus L.
    Aphis rumicis L.
Eupatorium ageratoides L.
    Aphis ageratoides Oestl.
    Macrosiphum eupatoris Will.

- Eupatorium perfoliatum L.
  - Aphis eupatorii Will.
  - Macrosiphum eupatorii Will.
- Euphorbia corrollata L.
  - Aphis euphorbiæ Kalt.
- Euphorbia maculata L.
  - Macrosiphum euphorbiæ Thos.
- Euphorbia marginata Pursh.
  - Macrosiphum euphorbicola Thos.
- Euphorbia sp.
  - Aphis asclepiadis Fitch.
- Fabia vulgaris.
  - Aphis cucumeris Forbes.
    - rumicis L.
- Fagus Americana Sweet. (F. ferruginea.)
  - Phyllaphis fagi L.
  - Schizoneura imbricator Fitch.
- Fragaria indica Andr. (Duchesna.)
  - Aphis aparines F.
    - gossypii Glover.
  - Macrosiphum fragaria Koch.
    - var. immaculata Riley.
    - minor Forbes.
- Fraxinus americanus L.
  - Pemphigus fraxinifolii Riley.
- Fraxinus nigra Marsh. (F. sambucifoli).
- Fraxinus quadrangulata Michx.
  - Pemphigus fraxinifolii Riley.
- Fungus.
  - Schizoneura corni F.
    - fungicola Walsh.
- Galium aparine L.
  - Aphis aparines F.
- Galium circæzans Michx.
  - Aphis circæzandis Fitch.
- Gaura parviflora Doughl.
  - Marcrosiphum gaurea Will.
    - gaurina Will.
    - sp. Cowen.
- Genista tinctoria L.
  - Aphis rumicis L.
- Geranium maculatum L.
  - Macrosiphum geranii Oestl.
- Geranium cultivated.
  - Macrosiphum perlargonii Kalt.
- Gerardia tenuifolia Vahl.
  - Macrosiphum gerardiæ Thos.
- German ivy.
  - Rhopalosiphum dianthi Schrank.
- Glycyrrhiza lepidota Nutt.
  - Aphis medicaginis Koch.

- Gossypium herbaceum L.
  - Aphis gossypii Glover.
  - Rhopalosiphum dianthi Schk.
- Grindelia squarrosa Pursh.
  - Macrosiphum grindeliæ Will.
  - Schizoneura corni F.
- Hamamelis virginica L.
  - Hormaphis hamamelidis Ost.-S.
    - spinosus Shimer.
- Helianthus grosse-serratus Mart.
  - Aphis helianthi Monell.
- Helianthus giganteus L.
  - Aphis helianthi Monell.
- Helianthus scaberrimus Ell. (H. rigidus.)
  - Aphis helianthi Monell.
- Helianthus tuberosus L.
  - Aphis Helianthi Monell.
- Helianthus sp.
  - Aphis helianthi Monell.
    - gillettei Cowen.
- Heuchera hispida Pursh.
  - Macrosiphum heucheræ Thos.
- Hibiscus cultivated.
  - Aphis gossypii Glover.
    - malvæ Walker.
  - Rhopalosiphum dianthi Schrank.
- Hordeum jubatum L.
  - Aphis sp. Will.
  - Macrosiphum avenæ F.
  - Schizoneura corni F.
- Humulus lupulus L.
  - Aphis gossypii Glover.
  - Phorodon humuli Schrank.
- Hydrangea sp.
  - Aphis gossypii Glover.
- Hypericum kalmianum L.
  - Callipterus hyperici Monell.
- Impatiens aurea Muhl. (I. pallida).
  - Macrosiphum carnosa impatiens Will.
- Impatiens biflora Walt. (I. fulva).
  - Aphis impatiens Thos.
  - Macrosiphum camosa impatiens Will.
    - fulvæ Oestl.
- Iris pumila L.
  - Rhopalosiphum dianthi Schrank.
- Isatis tintoria L.
  - Aphis brassica L.
- Japanese lillies.
  - Macrosiphum lilii Monell.

- Juglans nigra L.
  - Calliptenus caryæ Monell.
  - Lachnus longistigma Monell.
  - Schizoneura caryæ Fitch.
- Juncus.
  - Rhopalosiphum nymphææ L.
- Kale.
  - Aphis brassicæ L.
- Kohlrabi.
  - Aphis brassica L.
- Laburnum vulgare Gris.
  - Aphis rumicis L.
- Lactuca pulchella Dc.
  - Macrosiphum erigeronensis Thos.
- Lactuca sativa L.
  - Macrosiphum lactucæ Kalt.
  - Rhizobius lactucæ Kalt.
- Lactucæ sp.
  - Macrosiphum lactucæ Kalt.
    - muralis Buckt.
    - rudbeckiæ Fitch.
  - Rhopalosiphum dianthi Schrank.
- Lappa major Gærtn. (Arctium.)
  - Aphis gossypii Glover.
- Laris laracina Du Roi.
  - Chermes laricifolæ Fitch.
    - strobilobus Kalt.
  - Lachnus larcifex Fitch.
- Lathyrus odoratus L.
  - Macrosiphum pisi Kalt.
- Leersia virginica Willd.
  - Tetraneura graminis Monell.
- Lemna minor L.
  - Aphis sambuci L.
- Lepidium virginicum L.
  - Aphis gossypii Glover.
- Leptilon canadense (see Erigeron).
- Lilium sp.
  - Aphis lilicola Will.
  - Macrosiphum lilii Monell.
  - Rhopalosiphum dianthi Schrank.
- Liriodendron tulipifer L.
  - Macrosiphum liriodendri Monell.
- Lonicera dioica L. (L. glauca Hill).
  - Aphis lonicera Monell.
- Lonicera parviflora.
  - Aphis loniceræ Monell.
    - lonicericola Will.
- Lonicera sp.
  - Aphis loniceræ Monell.

- Lycopersicon lycopersicon L.
  - Aphis cucumeris Forbes.
  - Rhopalosiphum solani Schrank.
- Lycopersicon esculentum (see L. lycopersicon).
- Malva rotundifolia L.
  - Aphis gossypii Glover.
  - Myzus achyrantes Monell.
- Maruta cotula.
  - Aphis marutæ Oestl.
  - Myzus achyrantes Monell.
- Maurandia hendersoni.
  - Rhopalosiphum dianthi Schrank.
- Melilotus alba Lam.
  - Aphis medicaginis Koch.
- Melon.
  - Aphis cucumeris Forbes.
    - gossypii Glover.
- Mentha canadensis L.
  - Aphis menthæ-radicis Cowen.
  - Macrosiphum menthæ Buckt.
- Mentha spicata L.
  - Macrosiphum menthæ Buckt.
- Mentha viridis see M. spicata L.
- Mentzelia nuda Pursh.
  - Macrosiphum sp. Cowen.
- Mesadenia tuberosa Nutt.
  - Macrosiphum rudbeckiæ Fitch.
- Mimulus Jamesii T. & G.
  - Aphis mimuli Oestl.
- Mimulus ringens L.
  - Aphis mimuli Oestl.
- Mimulus virgens L.
  - Aphis mimuli Oestl.
- Monarda fistulosa L.
  - Aphis monardæ Oestl.
  - Phorodon monardæ Will.
    - sp. Ost.-S.
- Monarda punctata L.
  - Aphis monardæ Oestl.
  - Phorodon sp. Ost.-S.
- Muhlenbergia racemosa Michx.
  - Schizoneura corni F.
- Mulgedium sp.
  - Macrosiphum rudbeckiæ Fitch.
- Mustard.
  - Aphis brassicæ L.
- Nabalus albus L.
  - Rhopalosiphum nabali Oestl.
- Naias flexilis Will.
  - Rhopalosiphum nymphææ L.

- Nasturtium annoracia.
  - Aphis annoracia Cowen.
- Nasturtium sinuatum.
  - Pemphigus burrowi n. sp.
- Nectarine.
  - Myzus persicæ Sulz.
- Negundo aceroides Moench.
  - Chaitophorus negundinis Thos.
- Neilla opulifolia L.
  - Aphis neilliæ Oestl.
- Nelumbo lutea Willd.
  - Rhopalosiphum nymphææ L.
- Nepeta glachoma Benth.
  - Aphis gossypii Glover.
- Nerium oleander L.
  - Aphis asclepiadis Fitch.
  - Aphis nerii Fonsc.
  - Rhopalosiphum dianthi Schrank.
- Nicotiana sp.
  - Rhopalosiphum dianthi Schrank.
- Nymphæa odorata Dry. (Castalia.)
  - Rhopalosiphum nymphææ L.
- Oats.
  - Macrosiphum avenæ F.
  - Toxoptera graminum Rond.
- Œnothera biennis L.
  - Aphis œnotheræ Oestl.
  - Macrosiphum sp. Will.
  - Myzus œnotheræ Will.
  - Pemphigus œnotheræ Will.
- Œnothera cæsiptosa Nutt.
  - Aphis œnotheræ Oestl.
- Œnothera sp.
  - Aphis œnotheræ Oestl.
- Onoclea strutheopteris L.
  - Rhopalosiphum ampullata Buckt.
- Opulaster (see Neilla).
- Oxytropus (see aragullus).
- Ostrya virginiana Mill.
  - Macrosiphum gerardiæ Thos.
- Oxalis stricta L.
  - Aphis maidi-radicis Forbes.
  - Rhopalosiphum dianthi Schrank.
- Oxybaphus (see Alleonia).
  - Panicum crus-carvi.
  - Aphis setariæ Thos.
- Panicum crus galli L.
  - Aphis annuæ Oestl.
    - setariæ Thos.
  - Geoica squamosa Hart.
  - Schizoneura panicola Thos.

- Panicum glabrum Gand.
  - Schizoneura corni F.
    - panicola Thos.
  - Thychea panici Thos.
- Panicum capillare L.
  - Schizoneura corni F.
- Panicum proliferum Lam.
  - Aphis setariæ Thos.
  - Schizoneura corni F.
- Panicum sanguinalis L.
  - Schizoneura corni F.
- Panicum sp.
  - Colopha eragrostidis Midd.
- Papaver somniferum L.
  - Aphis rumicis L.
- Parsonsia platycentra.
  - Aphis malvae Walker.
- Parthenocissa quinquefolia L.
  - Aphis parthenocissa Will.
    - setariæ Thos.
- Pea.
  - Macrosiphum pisi. Kalt.
- Peach.
  - Aphis persicæ-niger Smith.
  - Myzus persicæ Sulz.
- Phalaris canariensis L.
  - Macrosiphum avenæ F.
- Phaseolus nanus.
  - Aphis gossypii Glover.
- Phragmites phragmites L.
  - Hyalopteris arundinis Koch.
- Picæ sp.
  - Chermes abieticolens Thos.
    - abietis L.
- Pinus australis.
  - Lachnus australis Ashm.
- Pinus echinata Mill.
  - Aphis marginipennis Hald.
- Pinus scopulorum Engel.
  - Lachnus flocculosa Will.
    - pini L.
    - ponderosa Will.
- Pinus strobus L.
  - Chermes pinicorticis Fitch.
  - Lachnus rileyi Will.
    - strobi Fitch.
  - Schizoneura pinicola Thos.
- Pinus silvestris L.
  - Lachnus pini L.
    - rileyi Will

Pinus sp.
    Chaitophorus pinicolens Fitch.
Pisum sativum L.
    Macrosiphum pisi Kalt.
Plantago major L.
    Aphis maidi-radicis Forbes.
        maidis Fitch.
    Myzus plantaginis Pass.
Plantago virginica L.
    Aphis gossypii Glover.
Platanus occidentalis L.
    Aphis quercifoliæ Walsh.
    Lachnus platanicola Riley.
Poa annua L.
    Aphis annuæ Oestl.
    Rhizobius poæ Thos.
    Siphocoryne avenæ F.
Poa compressa L.
    Aphis annuæ Oestl.
    Rhopalosiphum dianthi-poæ Will.
    Siphocoryne avenæ F.
Poa pratensis L.
    Aphis salicola Thos.
    Forda occidentalis Hart.
    Geoica squamosa Hart.
Polanasia graveolens Raf.
    Aphis polanisiæ Oestl.
Polianthes tuberosis L.
    Rhopalosiphum dianthi Schrank.
Polygonum aviculare L.
    Schizoneura corni F.
Polygonum pennsylvanicum L.
    Aphis sp. Will.
Polygonum persicaria L.
    Aphis maidis Fitch.
    Macrosiphum polygoni Walk.
Polygonum Hartwrightii Walk.
    Macrosiphum sp. Ost.-S.
Populus alba L.
    Chaitophorus populi L.
Populus angulorum Cham.
    Chaitophorus populicola Thos.
    Pemphigus populicaulis Fitch.
                pseudobyrsa Walsh.
Populus lævigata angustifolia Bebb.
    Pemphigus populimonilis Riley.
    Chaitophorus populicola Thos.

- Populus balsamifera L.
  - Pemphigus monilis Riley.
    - popularius Fitch.
    - populiglobuli Fitch.
    - populiramulorum Riley.
    - populitransversus Riley.
    - populivenæ Fitch.
- Populus balsamifera candicans Ait.
  - Chaitophorus candicans Thos.
  - Pemphigus salicis Linn.
- Populus deltoides Marsh (P. monilifera).
  - Chaitophorus populicola Thos.
    - populifoliæ Fitch.
  - Cladobius saliciti Harris.
  - Pemphigus populicaulis Fitch.
    - populiconduplifolius Cowen.
    - populiramulorum Riley.
    - populitransversus Riley.
    - pseudobyrsa Walsh.
    - vagabundus Walsh.
  - Phylloxera prolifera Oestl.
- Populus dilata Ait.
  - Chaitophorus populi L.
- Populus granidentata Michx.
  - Aphis populifoliæ Fitch.
  - Chaitophorus populi L.
    - populifoliæ Fitch.
- Populus nigra L.
  - Chaitophorus populi L.
- Populus tremuloides Michx.
  - Chaitophorus bruneri Will.
    - populi L.
    - populicola Thos.
    - sp. Ost.-S.
  - Pemphigus populicaulis Fitch.
- Populus sp.
  - Cladobius salicti Harris.
  - Pemphigus popularia Fitch.
    - vagabundus Walsh.
- Portulaca oleracea L.
  - Aphis gossypii Glover.
    - maidi-radicis Forbes.
- Potamogeton sp.
  - Rhopalosiphum nymphææ L.
- Potato.
  - Aphis cucumeris Forbes.
    - rumicis L.
  - Rhopalosiphum dianthi Schrank.
- Potentillatina anserina L.
  - Macrosiphum potentillæ Oestl.
  - Myzus rosarum Walk.

- Potentilla arguta Pursh.
  - Mysus potentillæ Will.
- Prunus domestica L.
  - Aphis pruni Koch.
    - prunifolia Fitch.
  - Hyalopteris pruni F.
  - Myzus cerasi F.
    - mahaleb Fonsc.
    - persicæ Sulz.
  - Phorodon humuli Schrank.
  - Rhopalosiphum sp. Lint.
  - Schizoneura corni F.
- Prunus instititia L.
  - Phorodon humuli Schrank.
- Prunus serotina Ehrh.
  - Aphis cerasicolens Fitch.
- Prunus spinosa L.
  - Phorodon humuli Schrank.
- Prunus virginiana L.
  - Aphis cerasifoliæ Fitch.
- Prunus sp.
  - Hyalopteris arundinis F.
  - Macrosiphum prunicola Ashm.
- Pseudosuga douglassi Carr.
  - Chaitphorus sp.
- Pteris aquilina L. (Pteridum).
  - Mastopoda pteridis Oestl.
- Pyrus americana (see Sorbus).
- Pyrus coronaria L. (Malus).
  - Schizoneura lanigera Hausm.
- Pyrus malus L. (Malus).
  - Aphis mali F.
  - Callipterus mucidus Fitch.
  - Lachnus dentatus Le B.
  - Myzus sp. Sanderson.
  - Rhopalosiphum serotina Oestl.
  - Schizoneura lanigera Hausm.
- Quercus alba L.
  - Lachnus quercifoliæ Fitch.
  - Phylloxera rileyi Licht.
- Quercus bicolor, Q. platanoides Lam.
  - Callipterus discolor Monell.
    - punctata Monell.
  - Phylloxera rileyi Licht.
- Quercus coccinea Wang.
  - Callipterus bellus Walsh.
    - sp. Ost.-S.
- Quercus imbricaria Michx.
  - Callipterus hyalinus Monell.

- Quercus macrocarpus Michx.
  - Callipterus bellus Walsh.
    - discolor Monell.
    - punctatus Monell.
  - Chaitophorus spinosa Oestl.
  - Schizoneura querci Fitch.
- Quercus obtusifolia Michx. (Q. minor.)
- Quercus phellos L.
  - Phyllaphis niger Ashm.
- Quercus prinus L.
  - Chaitophorus quercicola Monell.
- Quercus rubra L.
  - Callipterus bellus Walsh.
    - quercifolii Thos.
- Quercus undulata Torr.
  - Schizoneura querci Fitch.
- Quercus virginiana Mill. (Q. virens.)
  - Lachnus quercicolens Ashm.
- Quercus sp.
  - Aphis quercicola Walsh.
  - Callipterus quercicola Monell.
  - Schizoneura querci Fitch.
- Radish.
  - Aphis brassicæ L.
- Raphanus sativus L.
  - Aphis sp. Cowen.
- Raphinus lanceolata.
  - Aphis frangulæ Kalt.
- Rhus glabra L.
  - Pemphigus rhois Fitch.
  - Rhopalosiphum rhois Monell.
- Ribes aureum Pursh.
  - Myzus ribes L.
- Ribes cynosbati L.
  - Macrosiphum cynosbati Oestl.
- Ribes rotundifolium Michx.
  - Macrosiphum sp. Will.
  - Myzus ribis L.
- Ribes viscossisium Pursh.
  - Myzus ribis L.
- Robina pseudacacia L.
  - Rhopalosiphum dianthi Schrank.
- Robina viscosa Vent.
  - Aphis medicaginis Koch.
- Rose.
  - Macrosiphum pallida Oestl.
    - rosæ florida Ashm.
  - Myzus rosarum Walker.
- Rubus occidentalis L.
  - Pemphigus rubi Thos.

- Rubus strigosus Michx.
  - Aphis rubicola Oestl.
  - Nectarosiphon rubicola Oestl.
- Rubus villosus Ait.
  - Macrosiphum rubi Kalt.
  - Sipha rubifolii Thos.
- Rudbeckiæ lacinata L.
  - Macrosiphum rudbeckiæ Fitch.
- Rumex acetosa L.
  - Aphis rumicis L.
- Rumex altissimus Wood.
  - Aphis atriplicis L.
    - maidis Fitch.
    - rumicis L.
- Rumex crispus L.
  - Aphis gossypii Glover.
    - maidi-radicis Forbes.
    - rumicis L.
- Rumex lapathum.
  - Aphis rumicis L.
- Rumex venosus Pursh.
  - Aphis rumicis L.
- Rumex sp.
  - Aphis rumicis L.
- Ruta Baga L.
  - Aphis brassica L.
- Sagittaria latifolia Wild. (S. varabilis Eng.)
  - Rhopalosiphum nymphææ L.
- Salix alba L.
  - Chaitophorus viminalis Monell.
  - Cladobius salicis L.
    - smithiæ Monell.
- Salix amygdaloides Anders.
  - Aphis salicola Thos.
- Salix babylonica L.
  - Chaitophorus viminalis Monell.
  - Siphocoryne salicis Monell.
- Salix discolor Muhl.
  - Aphis salicola Thos.
- Salix interior Rowl. (S. longifolia M.)
  - Chaitophorus nigræ Oestl.
    - sp. Ost.-S.
  - Cladobius salicis Monell.
- Salix lucida Muhl.
  - Chaitophorus viminalis Monell.
  - Cladobius salicis L.
  - Siphocoryne salicis Monell.
- Salix nigra Marsh.
  - Chaitophorus nigræ Oestl.
  - Siphocoryne salicis Monell.

- Salix viminalis L.
  - Cladobius salicis L.
- Salix sp.
  - Aphis salicicola Thos.
  - Callipterus viminalis Monell.
  - Chaitophorus cordata Will.
    - salicis Will.
    - salicte Schrank.
  - Cladobius bicolor Oestl.
    - flocculosus Weed.
    - salicis L.
    - saliciti Harris.
    - sp. Ost.-S.
  - Lachnus dentatus Le B.
    - salicellis Fitch.
    - viminalis Fonsc.
- Sambucus canadensis L.
  - Aphis sambucifolii Fitch.
- Saniculata canadensis L.
  - Aphis saniculæ Will.
- Sarothamus scoparius.
  - Macrosiphum menthæ Buckt.
- Scropularia nodosa L.
  - Macrosiphum sp. Ost.-S.
  - Phorodon scropulariæ Thos.
- Senapis nigra Koch. (Brassica.)
  - Aphis brassicæ L.
- Senechio canus Hook.
  - Aphis senichionis Will.
- Senechio cineraria DC.
  - Macrosiphum circumflexa Buckt.
- Senechio lugens Rich.
  - Aphis lugentis Will.
- Setaria italica germanica ochloa Mill.
  - Aphis maidi-radicis Forbes.
  - Schizoneura corni F.
- Setaria glauca L. (Chætochloa.)
  - Aphis maidis Fitch.
    - setariæ Thos.
  - Schizoneura corni F.
- Setariæ viridis L. (Chætochloa.)
  - Aphis maidis Fitch.
  - Schizoneura corni F.
- Silphium perfoliatum L.
  - Macrosiphum rudbeckiæ Fitch.
- Smilax herbacea L.
  - Lachnus smilacis Will.
- Smilax rotundifoliæ L.
  - Pemphigus attenuatus Ost.-S.
- Smilax sp.
  - Pemphigus vagabundus Walsh.

- Solanum jasminoides Paxt.
  - Macrosiphum solanifolii Ashm.
- Solidago canadensis L.
  - Aphis solidaginifoliæ Ashm.
  - Macrosiphum solidaginis Fabr.
- Solidago missouriensis Nutt.
  - Macrosiphum luteola Will.
- Solidago rigidii L.
  - Macrosiphum rudbeckiæ Fitch.
  - Rhopalosiphum serotinæ Oestl.
- Solidago serotina Ait.
  - Aphis middletonii Thos.
  - Macrosiphum rudbeckiæ Fitch.
    - solidaginis F.
  - Rhopalosiphum serotinæ Oestl.
- Sonchus dianthi Schrank.
  - Rhopalosiphum dianthi Schrank.
- Sonchus oleraceus L.
  - Macrosiphum rudbeckiæ Fitch.
    - sonchella Monell.
    - sonchi L.
  - Rhopalosiphum dianthi Schrank.
- Sorbus americana Marsh.
  - Aphis mali F.
- Sorghum halpense L.
  - Aphis maidis Fitch.
  - Chaitophorus flavus Forbes.
- Spartini cynosuroides Willd.
  - Schizoneura corni F.
- Spinacia oleracea Will.
  - Aphis gossypii Glover.
- Spiraxis sp.
  - Macrosiphum circumflexa Buckt.
- Spirla ulmaria L. (Ulmaria.)
  - Macrosiphum pisi Kalt.
- Spruce.
  - Chermaphis abietis L.
- Squash.
  - Aphis cucumeris Forbes.
  - Macrosiphum cucurbitæ Thos.
- Stellaria media L. (Alsine.)
  - Aphis gossypii Glover.
- Sugar-beet.
  - Aphis atriplicis L.
    - gossypii Glover.
    - middletonii Thos.
    - sp. Hart.
  - Macrosiphum erigeronensis Thos.
    - pisi Kalt.
  - Myzus achyrantes Monell.
  - Pemphigus betæ Doane.

Symphoricarpus occidentalis Hook.
  Aphis albipes Oestl.
    symphoricarpi Thos.
Symphoricarpus pauciflorus Robb.
  Aphis albipes Oestl.
    symphoricarpi Thos.
Symphoricarpus symphoricarpus L. (S. vulgaris M.)
  Aphis albipes Oestl.
    symphoricarpi Thos.
Synosma suaveolens L.
  Macrosiphum rudbeckiæ Fitch.
Tenacetum vulgars L.
  Macrosiphum tanaceti Linn.
Tares.
  Macrosiphum pisi Kalt.
Taraxacum dens-leonis (T. officinale Web.)
  Aphis gossypii Glover.
Thalesia sp.
  Aphis middletoni Thos.
Thalictrum purpurascens L.
  Macrosiphum purpurascens Oestl.
    thalicti Oestl.
  Myzus thalicti Will.
Thaspium aureum Nutt.
  Aphis thaspii Oestl.
Thaspis bursa-pastoris (capsella).
  Aphis rumicis L.
Tillia americana L.
  Drepanosiphum tiliæ Koch.
  Lachnus longistigma Monell.
  Macrosiphum tiliæ Monell.
Tilia europea L.
  Lachnus longistigma Monell.
Timothy.
  Geoica squamosa Hart.
Tobacco.
  Macrosiphum tobaci Pergande.
Townsendia excapa Rich. (T. sericea H.)
  Rhopalosiphum dianthi Schrank.
Trifolium pratense L.
  Aphis bakeri Cowen.
    gossypii Glover.
    trifolii Oestl.
  Callipterus trifolii Monell.
  Macrosiphum sp. Ost.-S.
Trifolium repens L.
  Aphis cephalicola Cowen.
    trifolii Oestl.
  Macrosiphum pisi Kalt.

- Trifolium sp.
  - Callipterus trifolii Monell.
  - Geoica squamosa Hart.
  - Macrosiphum pisi Kalt.
- Tulipa gesneriana L.
  - Macrosiphum tulipæ Thos.
  - Rhopalosiphum dianthi Schrank.
    - tulipæ Thos.
- Tulipa.
  - Macrosiphum tulipæ Thos.
- Typha latifolia L.
  - Rhopalosiphum dianthi Schrank.
- Ulmaria ulmaria L.
  - Macrosiphum pisi Kalt.
- Ulmus americana L.
  - Callipterus ulmifolii Monell.
  - Colopha ulmicola Fitch.
  - Pemphigus walshi Will.
  - Tetraneura ulmi De G.
  - Schizoneura americana Riley.
- Ulmus pubescens Walt. (U. fulva).
  - Pemphigus ulmi-fusus Walsh.
- Ulmus racemosa Thos.
  - Colopha ulmicola Fitch.
  - Ulmus rubra (U. fulva Michx).
  - Callipterus bella Walsh.
  - Chaitophorus quercifoliæ Thos.
- Ulmus suberosus.
  - Tetraneura ulmi De G.
- Ulmus sp.
  - Lachnus ulmi L.
- Urtica dioica Pursh.
  - Macrosiphum pisi Kalt.
- Urtica gracilis Ait.
  - Macrosiphum pisi Kalt.
- Valeriana edulis Nutt.
  - Aphis valerinæ Cowen.
- Veratrum californicum Durand.
  - Aphis veratri Cowen.
- Verbena sp.
  - Macrosiphum verbenæ Thos.
- Vernonia fusciculata Michx.
  - Aphis middletoni Thos.
    - vernoniæ Thos.
  - Macrosiphum rudbeckiæ Fitch.
- Vernonia lindheimeriana Eng. & Gray.
  - Macrosiphum rubeckiæ Fitch.
- Vernonia novæboracensis L.
  - Macrosiphum rudbeckiæ Fitch.
- Vernonia sp.
  - Aphis middletoni Thos.

Vicia cracca L.
    Aphis rumicis L.
Vicia gigantea Hook.
    Macrosiphum pisi Kalt.
Vicia ludoviciana Nutt.
    Macrosiphum pisi Kalt.
Vicia villosa.
    Macrosiphum pisi Kalt.
Vicia sp.
    Macrosiphum pisi Kalt.
Violet.
    Rhopalosiphum violæ Pergande.
Viburnum opulus L.
    Aphis rumicis L.
        viburni Scop.
Vitis riparia Michx.
    Aphis ripariæ Oestl.
Vitis cordifolia Michx.
    Aphis ripariæ Oestl.
    Macrosiphum viticola Thos.
    Phylloxera vastatrix Planch.
Vitis sp.
    Aphis vitis Scop.
    Macrosiphum viticola Thos.
    Phylloxera vastatrix Planch.
Wahoo (Euonymus atropurpureus Jacq).
    Aphis rumicis L.
Wheat.
    Aphis mali F.
    Callipterus ulmifolii Will.
        sp. Will.
    Megoura sp. Will.
    Rhopalosiphum sp. Will.
    Siphocoryne avenæ F.
    Toxares sp. Will.
    Toxoptera graminum Rond.
Xanthium canadense Will.
    Siphocoryne xanthi Oestl.
Yucca glauca Nutt. (Y. angustifolia Pursh.)
    Aphis yuccæ Cowen.

CATALOGUE OF NORTH AMERICAN APHIDIDÆ AND HOST-PLANT LIST.

Genus APHIS.

- aceriodes Raf.
- adianthi Oestl.
  - Adianthum pedatum L.
- ageratoidis Oestl.
  - Eupatorium ageratoides L.
- albipes Oestl.
  - Symphoricarpos pauciflorus Robb.
    - symphoricarpus L.
    - vulgaris M.
    - occidentalis Hook.
- ambrosia Raf.
- amidis F.
  - Corn.
- annuæ Oestl.
  - Panicum crus-galli L.
  - Poa annua L.
  - Poa compressa L.
- annulipes Raf.
  - Hieracium gronovia.
    - paniculatum.
- aparines F.
  - Fragaria idica Andr. (Duchesna.)
  - Galium aparine L.
- apocyni Koch.
  - Apocynum androsamifolium L.
    - cinnabium L.
- aquilega canadensis Raf.
- arabia-hispida Raf.
- arabis-mollis Raf.
- armoraciæ Cowen.
  - Apocynum sp.
  - Euphorbium sp.
  - Nasturtium armoracia Gray.
- asclepiadis Fitch.
  - Acerates angustifolia Nutt.
  - Apocynum cinnabium L.
    - sp.
  - Asclepias syriaca.
  - Asclepias speciosa Torr.
    - cornutum.
- atriplicis L.
  - Chenopodiaceæ sp.
    - hybridum.
  - Rumex altissimus Wood.

Genus APHIS.

- atriplicis L.
  - Sugar-beet.
- bakeri Cowen.
  - Trifolium pratense L.
- bicolor Hald.
- brassicæ L.
  - Brassica oleraceæ L.
    - arvensis L.
  - Broccoli.
  - Brussels sprouts.
  - Cauliflower.
  - Capsella bursa-pastoris L.
  - Isatis tintoria L.
  - Kale.
  - Kohl rabbi.
  - Mustard.
  - Radish.
  - Raphnus sativus.
  - Rutabaga.
  - Senapis nigra.
    - alba.
- calendulicola Monell.
  - Calendula micrantha.
- campanula Raf.
- candicans F.
- carduella Walsh.
  - Circium altissimum Willd.
  - Cnicus sp.
- cardui L.
  - Circium lanceolatum Hoffm.
  - Cnicus sp.
- castanea-vesca Hald.
- cephalanthi Thos.
  - Cephalantaus occidentalis L.
- cephalicola Cowen.
  - Trifolium repens L.
- cerasicolens Fitch.
  - Cerasus serotina L.
  - Prunus serotina Ehrh.
- cerasifoliæ Fitch.
  - Cerasus serotina L.
  - Prunus virginiana L.
- chenopodii Cowen.
  - Chenopodium album L.
- circæzandis Fitch.
  - Galium circæzans Michx.
- citri Ashm.
  - Citrus sp.

Genus Aphis.

- coreopsidis Thos.
  - Coreopsis aristosa Michx.
- cornifoliæ Walsh.
  - Cornus candidissima Marsh.
    - florida L.
    - stolonifera Michx.
- cratægifoliæ Fitch.
  - Cratægus coccinea L.
    - punctata Jacq.
    - tomentosus L.
- cratægus coccinea Raf.
- diervilla-lutea Raf.
- dilepha Raf.
- diospyris Thos.
  - Diosporos virginiana L.
- discolor Hald.
- erigeron canadense Raf.
- erigeroni Cowen.
  - Erigeron umbellatum.
    - alatum.
- erigeron philadelpheum Raf.
- erigeron strigosum Raf.
- euonymi Fabr.
  - Euonymus atropurpureus.
- eupatorii Oestl.
  - Eupatorium perfoliatum L.
- euphorbiæ Kalt.
  - Euphoribia corollata L.
- forbesi Weed.
- frangulæ Kalt.
  - Raphnus lanceolata Pursh.
- frigidæ Oestl.
  - Artemisia frigida Willd.
- frondosa Oestl.
  - Bidens frondosa.
- furcipes Raf.
  - Primula veris.
  - Ballis peremnis.
- fusciclava Raf.
  - Many garden plants.
- gibbosa Raf.
  - Solidago.
- gilletti Cowen.
  - Amarantus retroflexus L.
  - Helianthus sp.
- gossypii Glover.
  - Acalypha virginica.
  - Alsine media L.
  - Amarantus sp.
  - Arctium lappa.

Genus APHIS.

- gossypii Glover.
  - Asclepiadora decumbens Gray.
  - Asparagus officinalis L.
  - Begonia.
  - Callirrhoe involucrata Gray.
  - Capsella bursa-pastoris.
  - Catalpa catalpa L.
  - Chenopodium album L.
  - Chenopodium anthelminthicum L.
  - Citrus aurantium L.
  - Citrullus citrullus Small.
  - Convolvulus sp.
  - Cornus mas.
  - Cucumus melo L.
  - Datura stramonium L.
  - Diodia teres Walt.
  - Fragaria indica.
  - Fragaria, cultivated.
  - Gossypium herbaceum L.
  - Hibiscus sp.
    - esculentus L.
  - Humulus lupulus.
  - Hydrangea.
  - Lagenaria lagenaria L.
  - Lappa major Gærtn.
  - Lepidium virginicum L.
  - Malva rotundifolia L.
  - Nepeta glachoma Benth.
  - Œnothera biennis L.
  - Ontogonia, in greenhouse.
  - Paspalum.
  - Phaseolus nanus.
  - Plantago virginica L.
  - Portulaca oleracea L.
  - Pyrus communis.
  - Quercus stellata Wang.
  - Rumex crispus L.
    - altissimus.
  - Scutellaria wrightii Gray.
  - Spinacea oleracea Will.
  - Stellaria media.
  - Sugar beet.
  - Taraxacum dens-leonis.
    - officinalis Webb.
  - Trifolium pratense.
  - Vidnis sinensis L.
- helianthi Monell.
  - Helianthus grosse-serratus Mart.
    - giganteus L.
    - scaberrimus Ell.

Genus Aphis.

- helianthi Monell.
  - Helianthus grosse-serratus Mart.
    - tuberosus L.
    - annus.
    - rigidus.
    - sp.
- heracli Cowen.
  - Heracleum lanatum.
- hieracium paniculatum Raf.
- hieracium venosum Raf.
- hyperici Monell.
  - Hypericum kalminium.
- illinoiensis Shimer.
  - Grape.
- impatiens Thos.
  - Impatiens biflora Walt.
    - fulva Walt.
    - pallida.
- loniceræ Monell.
  - Lonicera dioca L.
    - glauca Hill.
    - parviflora.
    - sp.
- jacobea balsamita Raf.
- loniceræ Monell.
- lutescens Monell.
  - Apocynum cinnabium L.
  - Asclepias incarnata L.
    - syriaca L.
- maculata Oestl.
  - Cornus candidissima Marsh.
    - paniculata L.
    - sp.
- maidi-radicis Forbes.
  - Amarantus hybridus L.
  - Corn.
  - Erigeron canadensia L.
  - Oxalis stricta L.
  - Plantago major L.
  - Portulaca oleraceæ L.
  - Rumex crispus L.
  - Setaria italica germanica ochloa Mill.
- maidis Fitch.
  - Kaffir corns.
  - Setaria glauca.
  - Sorghums cultivated.
  - Sorghum halpense.
  - Zea mays.
- marutæ Oestl.
  - Maruta cotula and Cratægus.

Genus APHIS.

- medicaginis Koch.
  - Argallus lamberti Pursh.
  - Astragulus bisulcatus Hook.
  - Caragana arborescens Lam.
  - Glycyrrhiza lepidota Nutt.
  - Melilotus alba Lam.
  - Robina viscosa.
- middletoni Thos.
  - Ambrosia trifida L.
  - Aster sp.
  - Erigeron canadensis L.
    - ramosus Nutt.
  - Solidago serotina.
  - Sugar-beet.
  - Thalesia sp.
  - Vernonia fusciculata Michx.
    - sp.
- mimuli Oestl.
  - Mimulus jamesii T. & G.
    - ringens L.
    - virgens L.
- monardæ Oestl.
  - monarda fistulosa L.
    - punctata L.
- neilliæ Oestl.
  - Neilla opulifolia L.
- nerii Fonsc.
  - Nerium oleander L.
  - Asclepias.
- onotheræ Oestl.
  - Onothera biennis L.
    - cæspitosa Nutt.
    - serrulata.
- oreaster Raf.
  - Highland asters.
- oxybaphi Oestl.
  - Oxybaphus angustifolius.
    - nyctagineus.
- pastinaceæ Koch.
  - Celery.
- persicæ-niger E. F. Smith.
  - Peach, cultivated.
- pilosa Hald.
  - Exotic species of willow.
- polanisiæ Oestl.
  - Polanisia graveolens.
- polygala-senaga Raf.
  - Polygala senaga.
- populifolia Fitch.
  - Populus granididentata Michx.

Genus APHIS.

- populus trepida Raf.
    - Populus trepida.
- prunicola Kalt.
    - Plum, cultivated.
- prunicolens Ashm.
    - Prunus.
    - Chenapodium album L.
        - hybridum.
    - Euonymus atropurpurus Jacq.
        - europæns L.
    - Fabia vulgaris.
    - Genista tinctoria.
    - Laburnum vulgare Gris.
    - Papaver somniferum L.
    - Potato, cultivated.
    - Rumex altissimus Wood.
        - crispus L.
        - lapathum.
        - acetosa L.
        - venosus Pursh.
        - sp.
    - Viburnum opulis L.
- salicola Thos.
    - Poa pratensis L.
    - Salix amygdaloides Anders.
        - discolor Muhl.
        - sp.
- sambuci L.
    - Lemna minor L.
    - Sambucus racemosa.
- sambucifoliæ Fitch.
    - Sambucus canadensis.
- setariæ Thos.
    - Panicum proliferum Lam.
        - carvi.
        - crus-galli, on roots, L.
    - Parthenocissus quinquefolia L.
    - Setaria glauca L.
    - Setaria viridis.
- solidaginifoliæ Ashm.
    - Solidago canadensis L.
- spiraæ Oestl.
    - Spirea salicifolia.
- prunifoliæ Fitch.
    - Plum, cultivated.
- pteris-aquilinoides Raf.
    - Pteris aquilina L.
- quercicola Walsh.
    - Quercus sp.

Genus APHIS.
- quercifoliæ Walsh.
  - Acer dasycarpum.
  - Quercus sp.
  - Platanus occidentalis L.
- quercus-monticulei Hall.
- rhodryas Raf.
  - Wild rose.
- ripariæ Oestl.
  - Vitis cordifolia Michx.
    - riparia Michx.
- rosa-suaveolens Raf.
- rubecula Hald.
- rubicola Oestl.
  - Rubus strigosus Michx.
- rumicis L.
  - Atriplex hortensis L.
  - Bean, cultivated.
  - Bursa pastoris.
- symphoricarpi Thos.
  - Symphoricarpus racemosus var. pauciflorus Rolh.
    - occidentalis Hook.
    - vulgaris.
- thaspii Oestl.
  - Thaspium aureum Nutt.
- trifolii Oestl.
  - Trifolium pratense L.
    - repens, on roots, L.
- tritici Fitch.
- valerinæ Cowen.
  - Valneriana edulis Nutt.
- veratri Cowen.
  - Veratrum californicum Durard.
- verbena-hastata Raf.
- vernoniæ Thos.
  - Vernonia fasiculata Michx.
- verticolor Raf.
  - Several species of Glossanthia.
  - Hieracium venosum.
- viburnum acerifolium Raf.
  - Virburnum acerifolium.
- virburnum-opulus Raf.
  - Viburnum opulus.
- vitis Scop.
  - Grape, cultivated.
- xantholis Raf.
  - Solidago memoralis.
- yucca Cowen.
  - Yucca glanca Nutt.
    - angustifolia Pursh.

Genus CALLIPTERUS.

- asclepiadis Monell.
    - Asclepias syiaca L.
        - obtusifolis Michx.
        - cornutum.
- bellus Walsh.
    - Quercus rubra L.
        - macrocarpa Michx.
        - coccinea Wang.
- betulæcolens Fitch.
    - Betula papyracea Marsh.
- caryæ Monell.
    - Carya sp.
    - Juglans nigra L.
    - Carya olivæformis.
- castaneæ Fitch.
    - castanea vesca.
        - dentata Marsh.
    - Sativa americana.
- discolor Monell.
    - Quercus macrocarpa Michx.
        - bicolor Lam.
- hyalinus Monell.
    - Quercus imbricaria Michx.
- hyperici Monell.
    - Hypericum prolificum L.
        - kalmianum.
- mucidus Fitch.
    - Pyrus malus L.
- punctatus Monell.
    - Quercus bicolor.
        - macrocarpus Michx.
- quercicola Monell.
    - Quercus sp.
- quercifollii Thos.
    - Quercus rubra.
- trifolii Monell.
    - Trifolium pratense L.
        - sp.
- ulmifolli Monell.
    - Ulmus americana L.
- callipterus sp.
    - Quercus macrocarpa.
        - coccinea.
    - Carya olivæformis Nutt.

Genus CHAITOPHORUS Koch.

- aceris L.
    - Acer pennsylvanicum L.
- candicans Thos.
    - Populus balsamifera candidans.

Genus CHAITOPHORUS Koch.
- flavus Forbes.
  - Corn, cultivated.
  - Sorghum, cultivated.
    - halpense L.
  - Zea mays.
- negundinis Thos.
  - Negundo asceroides Moench.
  - Catalpa catalpa L.
- nigræ Oestl.
  - Salix nigra Marsh.
    - interior Rowl.
    - longifolia M.
- pinicolens Fitch.
  - Pinus sp.
- populi Linn.
  - Populus alba L.
    - angulorun Cham.
    - granidentia Michx.
    - nigra L.
    - tremuloides.
    - dilata.
    - deltoides Marsh.
- populicola Thos.
  - Populus monilifera.
    - angulata.
    - tremuloides Michx.
    - angustifolia.
    - lævigata angustifolia Bebb.
    - granidentia Michx.
- populifoliæ Fitch.
  - Quercus rubra.
  - Populus granidentia.
    - monilifera.
- quercicola Monell.
  - Quercus prinus L.
- quercifolia Thos.
  - Quercus rubra.
  - Ulmus rubra L.
- salicite Schrank.
  - Salix sp.
- spinosus Oestl.
  - Quercus macrocarpa Michx.
- viminalis Monell.
  - Salix alba L.
    - babilonica D.
  - Salix sp.

Genus CHERMAPHIS.
- abieticolens Thos.
  - Abies nigra Michx.
  - Picea sp.

- Genus CHERMAPHIS.
    - abietis Linn.
        - Abies nigra Michx.
        - Picea sp.
    - castanea Hald.
        - Castanea sp.
    - laricifoliæ Fitch.
        - Larix americana Du Roi.
            - laricana Du Roi.
    - pinicorticis Fitch.
        - Pinus strobus L.
    - strobilobius Kalt.
        - Larix americana Du Roi.
- Genus CLADOBIUS Koch.
    - bicolor Oestl.
        - Salix sp.
    - flocculosus Weed.
        - Salix sp.
    - populeus Kalt.
        - (Host unknown.)
    - salicis Linn.
        - Salix alba.
            - longifolia.
            - lucida.
            - viminalis.
            - sp.
        - Populus balsamifera candicans.
    - salicti Harris.
        - Acer sp.
        - Populus sp.
            - monilifera.
        - Salix sp.
    - smithiæ Monell.
        - Salix alba.
    - sp.
        - Salix sp.
- Genus COLOPHA Monell.
    - eragrostidis Middleton.
        - Panicum sp.
        - Eragrostidis pœaoides megastachya.
            - franheulin.
            - purshii.
            - frankii.
    - ulmicola Fitch.
        - Ulmus americana and racemosa.
- Genus DREPANOSIPHUM Koch.
    - acerfolii Thos.
        - Acer dasycarpum.
            - saccharium.

- Genus Drepanosiphum Koch.
  - tiliæ Koch.
    - Acer saccharium.
    - Tilia americana.
- Genus Hormaphis.
  - cornu Shimer.
    - Hamamelis virginiana.
  - hamamelidis Osten-Sacken.
    - Hamamelis virginica.
  - papyraceæ Oestl.
    - Betula papyraceæ.
  - spinosus Shimer.
    - Betula papyraceæ.
    - Hamamelis virginica.
- Genus Hyalopteris.
  - arundinis Fabr.
    - Phragmantis communis.
- Genus Lachnus.
  - abietis Fitch.
    - Abies nigra and alba.
  - alnifolia Fitch.
    - Alnus rubra.
  - australis Ashm.
    - Pinus australis.
  - caryæ Harris.
    - Carya porcina.
  - dentatus Le Baron.
    - Salix sp.
  - laricificex Fitch.
    - Larix americana.
  - longistigma Monell.
    - Tillia americana.
      - europæa.
    - Populus balsamifera.
    - Carya amara.
    - Acer dasycarpum.
    - Cercis canadensis.
    - Platanus occidentalis.
    - Juglans nigra.
    - Quercus marylandica.
      - rubra.
  - pini Linn.
    - Pinus sylvestris.
      - ponderosa scopulorum.
  - platanicola Riley.
    - Platanus occidentalis.
  - querciolens Ashm.
    - Quercus virens.
  - quercifolia Fitch.
    - Quercus alba.

Genus LACHNUS.
- salicellis Fitch.
  - Salix sp.
- strobi Fitch.
  - Pinus strobus.
- ulmi Linn.
  - Ulmus sp.
- viminalis Fonsc.
  - Salix sp.

Genus MACROSIPHUM.
- absinthii L.
  - Artemisia absinthium L.
- ambrosia Thos.
  - Ambrosia trifida.
    - psilostachya.
- artemisia Koch.
  - Artemisia vulgaris.
- asclepiadis Fitch.
  - Asclepias cornuta.
- asclepiadis Cowen.
  - Asclepias speciosa.
- avenæ Fabr.
  - Wheat.
  - Agrostis vulgaris.
  - Bromus secalinus.
  - Dactylis glomerata.
  - Poa pratensis.
- callenduella Monell.
  - Calendula micrantha.
  - Bidens chrysanthemoides.
- caudata Pergande.
  - (Host unknown.)
- chrysanthemi Oestl.
  - Bidens chrysanthemoides.
- circumflexa Buckt.
  - Senechio cineraria.
  - Spiraxis sp.
- corydalis Oestl.
  - Corydalis aurea.
- cowenii n. n. Hunter, W. D.
  - Artemisia tridentata.
- cratægi Monell.
  - Cratægus coccinea.
- cucurbitæ Thos.
  - Egg-plant.
  - Squash.
- cynosbati Oestl.
  - Ribes cynosbati.
- epilobii Pergande.
  - Epilobium sp.

Genus MACROSIPHUM.

- erigeronensis Thos.
    - Erigeron canadense.
    - Lactuca pulchella.
    - Sugar-beet.
- euphorbicola Thos.
    - Euphorbia hypericifolia.
- fragariæ immaculata Riley.
    - Fragaria sp.
- frigidæ Oestl.
    - Artemisia frigida.
- fulvæ Oestl.
    - Impatiens fulva.
    - pallida.
- geranii Oestl.
    - Geranium maculata.
- gerardiæ Thos.
    - Gerardiæ tenuifolia.
- heucheræ Thos.
    - Heuchera hispida.
- insularis Pergande.
    - (Host-plant unknown.)
- lactucæ Kalt.
    - Lactuca sp.
    - Lettuce, cultivated.
- lilii Monell.
    - Lilium sp.
- liriodendri Monell.
    - Liriodendron tulipifera.
- ludovicianus Oestl.
    - Artemesia ludoviciana.
- menthæ Buckt.
    - Mentha canadensis.
    - Sarothammus scoparius.
- minor Forbes.
    - Fragaria sp.
- pallida Oestl.
    - Rosa sp.
- perlagoni Kalt.
    - Geranium, cultivated, in greenhouse.
- pisi Kalt.
    - Capsella bursa-pastoris.
    - Beet, cultivated.
    - Lathyrus odoratus.
    - Pea, cultivated.
    - Pisum sativum.
    - Spirea ulmaria.
    - Trifolium ripens.
    - Urtica gracilis.
    - dioica.

Genus MACROSIPHUM.

- polygoni Walk.
  - Polygonum persicaria.
  - Polygonum sp.
- potentillæ Oestl.
  - Potentilla anserina.
- prunicola Ashm.
  - Plum, cultivated.
- purpurascens Oestl.
  - Thalictrum purpurascens.
- rosæ Linn.
  - Rosa sp.
- rosæ, var. floridæ, Ashm.
  - Rosa sp.
- rubi Kalt.
  - Blackberry, cultivated.
- rudbeckiæ Fitch.
  - Ambrosia psylostachya.
    - trifidia.
  - Bidens chrysanthemoides.
  - Cacalia suavolens and tuberosa.
  - Circium arvenæ.
  - Cnicus sp.
  - Lactuca sp.
  - Mulgedium sp.
  - Rudbeckiæ laciniata.
  - Silphium perfoliatum.
    - integrefolium.
  - Solidago rigida.
    - serotina.
  - Sonchus oleraceus.
  - Vernonia fasiculata.
    - lindheimeri.
    - novoborascensis.
- solanifolii Ashm.
  - Solanum jasminoides.
- solidaginis Fabr.
  - Solidago canadensis.
    - seritona.
- sonchella Monell.
  - Sonchus oleraceus.
- tobaci pergande.
  - Tobacco.
- thalcitri Oestl.
  - Thalicitrum purpurascens.
- tenaceti Linn.
  - Tenacetum vulgare.
- tiliæ Monell.
  - Tilia americana.
- tulipæ Monell.
  - Tulip gesneriana.

Genus MACROSIPHUM.
- verbenæ Thos.
  - Verbena sp.
- viticola Thos.
  - Vitis cordifolia.
  - Grapevine, cultivated.

Genus MASTOPODA Oestl.
- pteridis Oestl.
  - Pteris aquilina.

Genus MEGOURA.
- solani Thos.
  - Wheat, cultivated.

Genus MONELLIA.
- caryella Fitch.
  - Carya amara.
    - alba.

Genus MYZUS Pass.
- achyrantes Monell.
  - Amarantus sp.
  - Corn.
  - Malva rotundifolia.
  - Beet.
  - Solanum melongena.
- cerasi Fabr.
  - Cherry, cultivated.
  - Plum, cultivated.
- mahaleb Fonsc.
  - Plum.
  - Asparagus.
- persicæ Sulz.
  - Peach, cultivated.
  - Plum, cultivated.
  - Cherry.
  - Nectarine.
- plantaginis Pass.
  - Plantago major.
- ribis Linn.
  - Ribis cynosbati.
    - viscossissimum.
    - aureum.
- rosarum Walker.
  - Rose, cultivated and wild.
  - Potentilla anserina, in greenhouse.

Genus NECTAROSIPHON.
- rubicola Oestl.
  - Rubus strigosus.

Genus PEMPHIGUS.
- aceris Monell.
  - Acer saccharium.

Genus PEMPHIGUS.
- acerifolii Riley.
  - Acer saccharium.
- alni Provancher.
  - Alnus Sp.
- attenuatus Osborne-Sirrine.
  - Smilax rotundifoliæ.
- betæ Doane.
  - Achillæa anulosa.
  - Polygonum aviculare.
  - Sugar beet.
- burrowi n. sp.
  - Nasturtium sinuatum.
- formicarius Walsh.
  - In nest of Formica aphidicola.
- formicetorum.
- fraxinifolii Riley.
  - Fraxinus americana.
    - sambucifolia.
    - quadrangulata.
- imbricator Fitch.
  - Betula sp.
- popularis Fitch.
  - Populus balsamifera.
- populicaulis Fitch.
  - Populus tremuloides.
    - monilifera.
    - angulata.
- populiconduplifolius Cowen.
  - Populus monilifera.
- populiglobuli Fitch.
  - Populus balsamifera.
- populimonilis Riley.
  - Populus balsamifera.
    - angustifolium.
- populiramulorum Riley.
  - Populus balsamifera.
    - monilifera.
- populitransversus Riley.
  - Populus balsamifera.
    - monilifera.
- populivenæ Fitch.
  - Populus balsamifera.
- pseudobyrsa Walsh.
  - Populus monilifera.
    - angulata.
- rhois Fitch.
  - Rhus glabra.
- rubi Thomas.
  - Rubus occidentalis.

Genus PEMPHIGUS.
- stamineus Hald.
  - Acer dasycarpum.
- tessalata Fitch.
  - Alnus rubra.
  - Betula papyraceæ.
  - Ash.
- ulmifusus Walsh.
  - Ulma fulva.
- vagabundus Walsh.
  - Populus monilifera.

Genus PHORODON Passerini.
- humuli Schrank.
  - Prunus domesticus.
  - Humulus lupulus.
    - instiata.
    - spinosus.
- scrophulariæ Thos.
  - Scropulariæ nodosa.

Genus PHYLLAPHIS Koch.
- fagi Linn.
  - Fagus ferruginea.
- niger Ashm.,
  - Quercus phellos laurifoliæ.

Genus PHYLLOXERA Fonsc.
- Caryæ Fitch.
  - Carya alba.
- caryæavellana Riley.
  - Carya alba.
- caryæcaulis Fitch.
  - Carya amara.
    - glabra.
- caryæfallax Walsh.
  - Carya alba.
- caryæglobuli Walsh.
  - Carya alba.
    - glabra.
- caryægummosa Riley.
  - Carya alba.
- caryæren Riley.
  - Carya glabra.
- caryæscissa Riley.
  - Carya alba.
- caryæsemen Walsh.
  - Carya glabra.
- caryæsepta Shimer.
  - Carya glabra.
- caryævenæ Fitch.
  - Carya alba.

- Genus PHYLLOXERA Fonsc.
  - castanæ Fitch.
    - Castanea sativa americana.
  - conica Shimer.
    - Carya alba.
  - depressa Shimer.
    - Carya sp.
  - forcata Shimer.
    - Carya amara.
  - gibbosa Shimer.
    - Carya glabra.
  - minimum Shimer.
    - Carya amara.
  - prolifera Oestl.
    - Pemphigus populicaulis galls.
  - rileyi Licht.
    - Quercus alba.
      - bicolor.
      - obtusifolia.
  - spinosa Shimer.
    - Carya amara.
  - vastatrix Planchon.
    - Vitis cordifolia.
- Genus RHOPALOSIPHUM Koch.
  - ampullata Buckton.
    - Onoclea struthiopteris.
  - berberidis Kalt.
    - Berberidis vulgaris.
  - dianthi Schrank.
    - Asparagus officinalis.
    - Caladium eseulentum, in greenhouse.
    - Calla lily, in greenhouse.
    - Carnation pink, in greenhouse.
    - Catalpa, in greenhouse.
    - Corn, cultivated.
    - Crocus, garden, in greenhouse.
    - Cyranthus annuns, in greenhouse.
    - Gossypium herbaceum.
    - Hibiscus, in greenhouse.
    - Herera helix.
    - German ivy.
    - Iris pumila, in greenhouse.
    - Lactuca scariola.
    - Lilium sp., in greenhouse.
    - Maurandia hendersoni, in greenhouse.
    - Nicotina sp.
    - Oxalis, cultivated, in greenhouse.
    - Polianthus tuberosa, in greenhouse.
    - Robina pseudocacia.
    - Sonchus oleraceus.

- Genus RHOPALOSIPHUM Koch.
  - dianthi Schrank.
    - Townsendria senicea.
    - Tulip gesneriana, in greenhouse.
  - nabali Oestl.
    - Nabalus albus.
  - nymphææ Linn.
    - Alisma plantago.
    - Bidens chrysanthemoides.
    - Juncus.
    - Lemna minor.
      - polyrrhiza.
    - Naias flexillus.
    - Nelumbo lutea.
    - Potamogeton.
    - Sagittaria variabilis.
  - rhois Monell.
    - Rhus glabra.
  - serotinæ Oestl.
    - Pyrus malus.
    - Solidago serotina.
      - rigida.
  - solani Thos.
    - Tomato, cultivated.
  - tulipæ Thos.
    - Tulip gesneriana.
  - violæ Pergande.
    - Violets, especially in greenhouses.
- Genus SCHIZONEURA Hartig.
  - americana Riley.
    - Ulmus americana.
  - caryæ Fitch.
    - Percatus.
    - Carya sp.
    - Juglans nigra.
  - corni Fabr.
    - Andropogan furcatus.
    - Capsella bursa pastoris.
    - Cornus florida.
      - stolonifera.
      - asperifolia.
      - sanguinea.
      - sericea.
    - Eragrostis major.
      - pectinacea spectabilis.
    - Grindelia squarrosa, on roots.
    - Muhlenbergia racemosa.
    - Panicum capillare.
      - crus galli.
      - sanguinale.

- Genus SCHIZONEURA Hartig.
    - Panicum capillare.
        - proliferum.
        - glabrum.
    - Plum, cultivated.
    - Polygonum aviculare.
    - Setaria glauca.
        - viridis, on roots.
        - italica, on roots.
    - Spartina cynosuroides.
    - cratægi Oestl.
        - Cratægus coccinea.
            - punctata.
            - tomentosa.
    - lanigera Hausm.
        - Pyrus mali.
            - coronaria.
    - pinicola Thos.
        - Pinus strobus.
            - ponderosa var. scopulorum.
    - querci Fitch.
        - Quercus macrocarpa.
            - undulata.
    - rileyi Thos.
        - Ulmus americana.
- Genus SIPHA Passerini.
    - rubifolii Thos.
        - Blackberry, cultivated.
- Genus SIPHOCORYNE Passerini.
    - archangelicæ Oestl.
        - Archangelica atropupurea.
    - salicis Monell.
        - Salix babylonica.
            - lucida.
            - nigra.
    - xanthi Oestl.
        - Xanthium-canadense.

NOTE.—The Host lists contained herein are compilations including personal field observations. Many synonyms are known to be included in these lists, but it is almost impossible to verify all these at this period of my investigation.

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THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 9—April, 1906.
(Whole Series, Vol. XIII, No. 9.)

CONTENTS:

THE UNIONIDÆ OF KANSAS, PART I, ... *Richard E. Scammon.*

PUBLISHED BY THE UNIVERSITY,
LAWRENCE, KAN.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 9. APRIL, 1906. { WHOLE SERIES, VOL. XIII, NO 9.

THE UNIONIDÆ OF KANSAS, Part I.

AN ILLUSTRATED CATALOGUE OF THE KANSAS UNIONIDÆ.*

BY RICHARD E. SCAMMON.

With plates LXII to LXXXVI.

INTRODUCTION.

THIS paper is the first of a series in which the author will attempt to give an account of our present knowledge of the Unionidæ, or pearly, fresh-water mussels, of the state of Kansas.

It was originally intended to embody this material in a single paper, but in the course of the work it has been found advisable to divide it rather arbitrarily into three parts. The first part, as given herein, is an illustrated and descriptive catalogue of the *Unios* known to occur within the limits of the state; the second will be a discussion of their geographical distribution; the third will contain a description of the soft parts of each species. It is a matter of regret that this last cannot be included in the present paper, but as yet the material at hand is not sufficient to warrant such a report.

The literature dealing with the Kansas Unionidæ is not extensive. Barring a few descriptions of new species† (all of which have turned out to be synonyms), the only work done on the Kansas *Unios* is that of Call, which appeared as a series of six reports in the Washburn Laboratory of Natural Science Bulletin, from 1884 to 1887 (4, 5). These reports consist of a list of some forty-nine species, with notes on their distribution and synonymy. While this list will always be of great value to those working on the *Unios* of the western Mississippi region, it is preliminary in its character and hardly available to the average student. Modern synonymy, much of which Doctor Call has himself worked out, has reduced this list to forty species and three subspecies.

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*Submitted in partial fulfilment of the requirements for the degree of master of arts.

†See bibliography.

In this catalogue are listed sixty-one species and five subspecies. There is no doubt that future collecting will add many more species to this list. The author has tried to make certain of the identification and locality of every species listed, and, with three exceptions,* has examined native specimens of each. In the great majority of cases a large series was available for the study of each species.

The greater part of the material upon which this paper is based was obtained from the collection of the University of Kansas (built up through the efforts of Dr. F. H. Snow) and from the collection of the author from Douglas, Franklin, Johnson, Jefferson and Cherokee counties, and the Neosho river near the state line. Several correspondents over the state have contributed data and material. The author has also examined the collections of the Academy of Science, at Topeka; Ottawa University, at Ottawa; Kansas Agricultural College, at Manhattan; and Washburn College, at Topeka. In the last-named institution is deposited most of the material upon which Doctor Call based his report.

The classification followed in this paper is that of Simpson's "Synopsis of the Naiades" (20), and the description of the genera and higher groups are extracts from that acknowledged authority. Simpson's synonymy has been accepted in all cases save that of *Anodonta bealii*, which the author feels convinced is only another form of the highly variable *Anodonta grandis*. While strongly opposed on principle to varieties or subspecies among the Naiades, the author has adopted a number for the sake of convenience. Only those synonyms which seem to be of the most importance are given. Lindhall's correction of the orthography of the Naiades (24) has been adopted throughout.

As a number of measurements have been given in connection with the descriptions, it may be well to define them. The "longitudinal axis" of the shell is considered to be a line drawn through the ventral margins of the large anterior and posterior muscle cicatrices. The longest line which can be passed through the valve parallel to this axis is given as the length of the shell. The height is considered to be the length of the line passing through the umbones of the shell at right angles to the longitudinal axis. By taking this conception of the height, the sex variation of the shells of the higher *Unios* is eliminated from this measurement. It has seemed best to give the position of the umbones in relation to the length of the shell in more definite terms. To secure this relation in numerical terms, a line is dropped perpendicularly from the tip of the umbones to the greatest longitudinal axis, and the distance from the intersection of the two lines to the anterior margin of the valve is given as a decimal fraction of the entire length of the greatest longitudinal axis. This relation has been termed the umboidal ratio.

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* *Lampsilis higginsii, Quadrula speciosa, Q. aspera.*

The two following terms have been employed in the descriptions, and are suggested for general use. First, the word "interdentum," as signifying the plate bridging the space between the pseudocardinals and the laterals; second, the term "branchial outline," as indicating the slight groove to be seen in the cavity of many of the more solid *Unios*, and which is caused by the slightly raised outline of the branchiæ.

The statements concerning the general distribution of each species are derived in the main from Simpson's "Synopsis," and this information is therefore in almost every case to be credited to that author. In considering the distribution within the state, an effort has been made to extend due credit in all cases where exact localities are named. In dealing with this local distribution, Doctor Call's work (4) has been most valuable.

I wish here to express my thanks to those who have aided me in this work. These are due particularly to Dr. C. E. McClung, under whose direction this work was done, and who has by his numerous kindnesses and suggestions rendered it possible. The following gentlemen have kindly permitted me to examine the material under their charge, and in several cases to remove data and material for further study: Professor Wilson, of Ottawa University; Professor Shattuck, of Washburn College; Prof. E. A. Popenoe, of the Kansas State Agricultural College; and Mr. Eugene Smyth, curator of the Kansas Academy of Science.

I have received valuable material for study from Doctor Newlon, of Oswego; Mr. H. T. Martin, of the University; Mr. W. R. B. Robertson, Mr. Brenman, and Professor Smith, of Minneapolis, Kan. Mr. Wm. H. Dall, curator of mollusks, National Museum, has kindly contributed data which is credited in the text.

Although the geographical distribution is left for more extensive treatment in a future paper, the following outline of the hydrography of Kansas is inserted to make clear the geographical references in the notes:

The streams of Kansas reach the Mississippi by two channels — the Missouri river and the Arkansas river. The streams of the state group themselves into three general systems. To the north the Kansas system, consisting of the Kansas river and its tributaries and emptying into the Missouri on its approach to the east state line. This system drains the northern half of the state. The Osage river, together with its tributary, the Marais des Cygnes, drains a triangular area having for its limits the central third of the eastern state line and extending west as far as the ninety-seventh meridian. The Osage flows into the Missouri river about half-way across the state of that name. The southern half of the state is drained in the west by the Arkansas river, and in the east by a number of parallel streams flowing southward which I have called the "clear-water streams" of the southern drainage. These streams eventually join the Arkansas. The most important of these are the Verdigris, the Walnut, the Neosho, and the Spring.

Family UNIONIDÆ.

"Shell nacreous, with a thick epidermis, beaks usually sculptured, often showing the remains of nuclear shell; ligament opisthodetic; hinge with or without teeth, though with vestiges of them in every genus; when present, schizodont, and arranged as pseudocardinals and laterals; pallial line usually simple; prismatic border ordinarily narrow.

"Animal with labial palpi almost always wider than long; anal opening usually separated from the superanal; embryo a glochidium, the soft parts being inclosed in a bivalve shell, and borne in the outer or inner or all four leaves of the branchiæ." (Simpson.)

HETEROGENÆ.

"Male and female shells different. The latter are inflated in the post-basal region; embryos are contained in the ovisacs separated by a sulcus and occupying the hinder part of the outer gills." (Simpson.)

GENUS **TRUNCILLA** RAFINESQUE, 1819.

"Shell rounded or oval, solid, inflated, generally smooth and rayed with a delicate beak sculpture which has a tendency to be doubly looped, that in the female having a decided inflation in the post-basal region, which is thinner than the rest of the shell, of different texture, often toothed, and usually radially sculptured; laterals double in each valve, the inner in the right valve smaller. Animal generally having the inner gill united to the abdominal sac; female with a heavy flap of mantle which fills the post-basal swelling of shell and which has an inner ridge inside at some distance above the edge; marsupium very distinct, occupying the swollen part of the shell." (Simpson.)

Truncilla triquetra RAFINESQUE. Plate LXIII, fig. 1.

Truncilla triquetra Rafinesque, Ann. Gen. Sci. Phys. Brussels, XIII, 1820, p. 300, pl. LXXXI, figs. 1–4.

Unio triangularis Barnes, Amer. Jour. Sci., IV, 1823, p. 272, pl. XIII, fig. 17.

Unio formosus Lea, Trans. Amer. Phil. Soc., IV, 1834, p. 111, pl. XIV, fig. 41.

Shell small, fairly solid, roundly elongate, triangular in outline, inflated, females particularly so. Anterior maring projecting and decidedly rounded; ventral margin gently and regularly bowed, posterior margin oblique, straight or slightly rounded; dorsal margin short, straight or slightly curved. Umbones full, high, decurved. Anterior and lateral slopes fully rounded, umboidal ridge well marked; posterior slope abrupt and straight or slightly excavated, marked with numerous fine, continuous, very slightly elevated ridges. Epidermis smooth and shining in most cases, straw-yellow to honey color, strongly marked with rays of dark green made up of arrow-shaped spots. Lines of growth smooth, distinct, and continuous. Ligament short, thick, light or dark brown, lunule rather large.

Interior: Pseudocardinals high, erect, pointed, slightly serrate at the apices, double in each valve. Interdentum narrow and rounded, cut away in the right valve. Laterals short, slightly curved, high; thick. Anterior adductor cicatrix much longer than wide, well excavated. Posterior scars large, well impressed, distinct. Dorsal muscle scars large, three to five in number, located on the lower surface of the interdentum. Pallial line impressed in its anterior two-thirds. Cavity of the beaks and of the shell deep. Nacre milky white.

Height.	Length.	Breadth.	Um. ra.	
32*	0.50	27	0.30	♂

T. triquetra is distributed over the Mississippi region from western New York to Indian Territory. Its only recorded occurrence in Kansas is in the Marais des Cygnes river at Ottawa. It will probably be found throughout the eastern half of the state, although it is without doubt a rare species.

This is a distinctive species which will hardly be confused with any other found in the state. In no other form is the sexual dimorphism more pronounced; the female shell has an inflation which appears almost abnormal.

---

*All measurements are given in millimeters.

GENUS **LAMPSILIS** RAFINESQUE, 1820.

"Shell oval to elliptical, smooth or slightly concentrically sculptured, usually without a posterior ridge; epidermis generally smooth and shining, often brilliantly rayed; beak sculpture, for the most part, consisting of fine, parallel ridges, which show a tendency to fall into an anterior and a posterior loop; hinge with one or two pseudocardinals and one lateral in the right valve, and two pseudocardinals and two laterals in the left; female shell having a moderate and gradual inflation in the post-ventral region opposite the marsupium. Animal with the inner gills attached nearly or quite through entire length to the abdominal sac; marsupium occupying the hinder part of the outer gills; ovisacs distinct, separated by sulci, rounded below, having a fold near their bases, the whole projecting below the inner gills; mantle edge doubled and thickened, often swollen behind in a sort of flap in the female." (Simpson.)

Lampsilis ventricosa BARNES. Plate LXIII, fig. 2.

Unio ventricosus Barnes. Amer. Jour. Sci. and Arts, No. IV, 1832, pl. XXXII.

Unio occidens Lea. Trans. Amer. Phil. Soc., III, 1829, p. 435, pl. X, fig. 16.

Unio subovatus Lea. Trans. Amer. Phil. Soc., IV, 1831, p. 118, pl. XVIII, fig. 46.

Unio canadensis Lea. Proc. Acad. Nat. Sci. Phila., I, 1857, p. 85.

Shell large, of moderate thickness, subelliptical in females, elliptical in males; females much inflated, males less so. Anterior margin decidedly rounded; ventral margin nearly straight in female, bowed in male; posterior margin often slightly emarginate in the female, roundly pointed in the male; dorsal margin somewhat curved or straight. Umboidal ratio approximately one-third. Umbones large and full, marked with a few coarse ridges. Anterior umboidal slope rounded short; posterior slope long and flat in males, rather short and high in females. Shell generally smooth except in old specimens; lines of growth dark, continuous, imbricated. Epidermis from straw-yellow to dark brown, with a few posteriorly placed dark-green rays in some specimens. Ligament short, stout, black.

Interior: Pseudocardinals high, serrate, directed anteriorly, two in the left and one (with sometimes an anterior auxiliary one) in the right valve. Lateral teeth short or moderately long, highest posteriorly, slightly curved, anterior adductor cicatrix well impressed, large, much longer than wide, anterior retractor scar of good size, semicircular; posterior adductor well marked, large, about as long as wide; posterior retractor scar large, generally distinct from the adductor cicatrix. Pallial line impressed anteriorly. Dorsal scars form a prominent pitted line on the under surface of the interdentum. Cavity of beaks and shell very large. Nacre satin white, iridescent dorsally and posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
75	49	32	0.30	130°	♂	(Coll. K. A. S.)
108	72	51	.28+	144°	♂	(430.1).
145	97	....	.30	150°	♀	(Coll. K. S. A. C.)
93	64	48	.34	142°	♀	(431.1).
107	74	62	.30	142°	♀	(62.1).

Lampsilis ventricosa var. **satura** Lea. Not figured.
Unio satur Lea, Proc. Amer. Phil. Soc., v, 1852, p. 252.

To be distinguished from the typical species by the more delicate shell, and by the darker epidermis, which often has an olive-green cast. The anterior slope is generally longer and the posterior more truncated than in the species proper.

This species is found all over the Mississippi drainage and in the St. Lawrence system and Nelson river and its tributaries. The variety *satura* is found in the Southwest to the Sabine river, Texas. It has been reported from all the main rivers of the state. In the Kansas drainage system it is not common. Cragin has reported it from the Kansas river, at Topeka, and from Shunganunga creek, in Shawnee county. Popenoe, however, has never found it in the west-central part of the system in the course of his rather extensive collecting there. In the Wakarusa river, near Lawrence, it is a rare shell, and it has never been found in the Kansas at that place. In the Marais des Cygnes drainage this form is quite abundant, and it is still more so in the larger streams of the southern area. The animal prefers deep water and a muddy bed, although it is found in ripples. The distribution of the variety is coextensive with that of the species. As

Call has suggested (5), the difference between the two forms is probably dependent directly on individual habitat.

The sexual dimorphism is particularly striking, the inflated and sometimes posteriorly truncated females being readily distinguished from the longer and more flattened males. The decided variation in the color of the epidermis and the number and prominence of the lines of growth bear no relation to the sex. There is some variation in the thickness of the shell.

Lampsilis luteola LAMARCK. Plate LXIV, fig. 2.

Unio luteola Lamarck. An. sans Vert., VI, 1819, p. 79.

Shell large, of variable thickness, subelliptical, males slightly inflated, females decidedly so. Anterior margin rounded; ventral margin straight, often slightly bowed, much produced posteriorly in the female; posterior margin bluntly rounded in the male and obtusely angulate in the female; dorsal margin almost straight and meeting the posterior at an angle of from 145 to 150 degrees. Umboidal ratio from 0.15 to 0.25. Umbones prominent, somewhat inflated, marked by from eight to sixteen sharp undulate ridges. Epidermis smooth or rough, according to station, lines of growth prominent and continuous, color variable, generally straw yellow, sometimes rayed over the posterior portion of disk with bands of sage-green of variable thickness and frequency. Ligament stout, long, deep brown.

Interior: Pseudocardinals high, lamellar or columnar serrate, directed anteriorly, two in the left valve and one (and sometimes two) in the right. Laterals of moderate length, thin, highest posteriorly, slightly curved. Anterior adductor cicatrix large, well impressed, variable as to shape, but much longer than wide, retractor cicatrix large and well impressed. Posterior scars large, lightly impressed, often fused. Dorsal scars small, pits scattered over the cavity of the umbones. Pallial line well impressed anteriorly and well marked posteriorly. Cavity of beaks shallow, of shell rather large. Nacre white, sometimes slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Ventral posterior angle.	Dorsal posterior angle.		
119	56	38	0.25	107°	146°	♀	(72.1)
90	45	33	.25+	104°	152°	♀	(70.2)
*136	60	60	.19+	110°	150°	♀	(70.5)
128	62	45	.21+	146°	150°	♂	(6.1)
134	58	47	.18+	155°	145°	♂	(70.3)
131	56	45	.22+	127°	148°	♂	(70.6)

The general range of *Lampsilis luteola* is the Mississippi drainage southwest of the Brazos river, Texas, and Canada east of the Rocky Mountains. It is perhaps the most abundant and best distributed of the Kansas *Unios*, being a common species in all the drainage basins. Its reported western limit of range is the Blue river, at Manhattan (Popenoe), but doubtless it is to be found much farther west. I have reports of its occurrence from nearly 100 localities and I never visited a stream of any size in eastern Kansas along whose banks there were not to be found shells of this species.

L. luteola is a mud-loving species, and is most abundant in the larger and more sluggish streams. It is found in company with *L. anodontoides*, but it does not follow that species into the smaller tributaries.

The male and female shells differ not only in the posterior swelling of the valves but also in the relation of the lower posterior margin to the ventral one. In the female shells the angle between these two is approximately 105 degrees, in the males 145 degrees. The young female shells are often enormously distended posteriorly.

This species is often confused with *L. anodontoides*. The females of *luteola*, however, can be easily recognized by the great posterior swelling, and the males by their more rounded posterior margins and wide and heavy shells.

Lampsilis powellii LEA. Not figured.

Unio powellii Lea, Proc. Amer. Phil. Soc., v, 1852, p. 252; Trans. Amer. Phil. Soc., v, 1853, p. 270, pl. XIX, fig. 25.

Shell large, rather thin, elliptical in outline, neither inflated nor compressed. Anterior margin almost circularly rounded; ventral margin gently and evenly bowed; posterior margin roundly biangulate; dorsal margin rather long and straight. Umboidal ratio in specimens examined, 0.20.

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* An unusually swollen female.

Umbones rather flattened. Anterior and lateral slopes flattened and rounded; posterior slope very slightly excavated and marked with two radial lines. Epidermis smooth and generally shining, olive-brown. Ligament long and rather thick.

Interior: Pseudocardinals small, serrate, rather bluntly pointed, single in the right and double in the left valve. Laterals long, slightly curved, lamellar. Interdentum long, narrow, rounded. Anterior adductor cicatrix well impressed, large, much longer than wide; posterior scars large, very lightly impressed, confluent. Dorsal cicatrices on the lower surface of the interdentum. Pallial line well impressed in its anterior one-half and crenulate. Cavity of the beaks deep, of the shell moderately deep. Nacre white, decidedly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
110	0.50	39	0.20	146°	♂	(432.1)

L. powellii is a southern form, found from Guadalupe river, Texas, to the rivers of southern Kansas. It has been found in Spring river at Baxter Springs (Call), and a single male specimen was among a lot of material received by the author from Doctor Newlon and collected from the Neosho river at Oswego. Call (5) mentions that his specimen bears broad brownish rays over the dorsal slope. My specimen is too decorticated in this region to show this character, if present. Lea states that the shell is eradiate. *Powellii* can be distinguished from *L. luteola*, its nearest ally in local waters, by the smaller and less pointed pseudocardinals and the thinner, squarer and less inflated shell.

Lampsilis ligamentina LAMARCK. Plate LXV, fig. 2.

Unio ligamentina Lamarck. An. sans Vert., VI, 1819, p. 72.

Shell large, moderately thick—quite thick anteriorly—wide, elliptical, slightly compressed. Anterior margin rounded; ventral margin more or less bowed; posterior margin roundly triangulate; dorsal margin slightly curved. Umbones slightly inflated and marked with from five to ten fine undulated ridges. Anterior umboidal slope rather sharply rounded, umboidal ridge prominent and obtusely angled. Epidermis marked with numerous continuous coarse lines of growth which soon lose the triangulate character of the posterior margin as they approach the umbones, and so form one rounded curve posteriorly. Epidermis dark straw color in the young specimens and deep brown in the old; dark green rays of variable width run from the beaks to the ventral margin in young specimens and sometimes occur obscurely in old ones. Ligament very large, robust, dark brown.

Interior: Pseudocardinals massive, rather low, rounded serrate, double in the left and right, the right anterior being rudimentary. Laterals of variable length, curved, coarse, serrate. Interdentum of very variable length and width. Anterior adductor cicatrix deep, longer than wide, rough, set under the anterior pseudocardinal in the left valve; protractor cicatrix longer than wide, quite deep. Posterior scars large, impressed, confluent. Pallial line impressed anteriorly. Dorsal muscle scars large and deep, in the cavity of the beaks or on the lower surface of the interdentum, sometimes on the base of the anterior pseudocardinals. Cavity of the beaks moderate, of the shell rather large. Nacre, satin-white to salmon-pink, the last less common, somewhat iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
98	55	37	0.19	(480.1)
121	62	50	.18	(200.6)
98	60	39	.24	(490.1)
132	65	66	.26	(200.5)

Lampsilis ligamentina var. **gibba** SIMPSON. Not figured.

Unio crassus Sowerby, Conch. Icon, XVI, 1868, pl. XCV, fig. 520.

Lampsilis ligamentinus, var. *gibbus* Simpson, Proc. U. S. Museum, 1900, vol. XXII, p. 540.

To be distinguished from the true species by the greater prominence of the umboidal ridge and the fusing into one curve of the posterior and dorsal margins. This gives the specimens a peculiar humped appearance. The variety is generally smaller and darker colored, and the nacre is more frequently tinted with salmon.

Ligamentina is found in the entire Mississippi drainage, southern Michigan, western New York, and Ontario. The variety *gibba* occurs south from the Ohio river. The species proper occurs in all the Kansas drainage systems, but in the

Kansas river system it is uncommon. Cragin has reported it from Mill creek, Wabaunsee county, and it is occasionally found in the Wakarusa river. In the Marais des Cygnes and the eastern and southern rivers it is quite common, in fact, one of the most abundant shells in the latter. It has not been reported from the Arkansas river. The variety is confined to the eastern rivers of the southern drainage, where it is often more abundant than the true species.

Lampsilis higginsii LEA. Not figured.

Unio higginsii Lea, Proc. Acad. Nat. Sci. Phila., IX, 1857, p. 84.

"Shell thin, oblique, ventricose, very much unequilateral, rounded anteriorly, hinge fairly heavy ; beaks very prominent, full, incurved ; epidermis olive-green, polished, very much rayed ; cardinal teeth large, heavy, erect, crenulate, double in either valve ; laterals fairly long, moderately heavy, almost straight ; nacre either white or tingedwith salmon color." (Lea.)

L. higginsii ranges from Ohio west to Iowa, and thence to Kansas, according to Simpson. A specimen of this species from the Blue river is in the National Museum (Dall). The description given above is a translation of the Latin one published by Lea in the proceedings of the Philadelphia Academy of Science for 1857.

Lampsilis anodontoides LEA. Plate LXIV, fig. 1.

Unio anodontoides Lea. Trans. Amer. Phil. Soc., IV, 1834, p. 81, pl. VIII, fig. 11.

Shell of moderate size, fairly solid, oblong anterior margin shortly rounded ; ventral margin slightly curved, somewhat produced in females ; posterior margin roundly pointed in males, blunt in females ; dorsal margin straight or slightly curved and joining the posterior at an angle of from 150 to 160 degrees. Umboidal ratio, 0.20. Umbones prominent, and marked with from eight to ten slightly double-looped ridges. Anterior umboidal slope quite abruptly rounded ; lateral slope rounded and marked by a broad and exceedingly shallow furrow, ventrally in females. Posterior umboidal ridge well marked ; posterior slope very abrupt in old specimens, and often slightly excavated. Epidermis, from pale straw to rich yellow, radiate rather obscurely in the young; the rays hardly visible in old specimens. Epidermis smooth and shining in the young, roughened with dark, continuous lines of growth in old shells; posterior slope much roughened. Ligament long, rather thick, dark brown.

Interior: Pseudocardinals double in the left, and single, with sometimes an auxiliary; in the right, erect, thin, plate-like, slightly serrate at their tips. Laterals long, thin, straight, or nearly so. Anterior large, moderately impressed, elongate, fan-shaped. Posterior scars lightly impressed, confluent, rather large. Dorsal scars irregular as to numbers and position in umboidal cavity. Pallial line impressed for anterior third or fourth. Cavity of beaks slight, of the shell considerable. Nacre pearly white, often pink, in the central cavity, quite iridescent.

Length.	Height.	Breadth.	Dorsal-posterior. angle.	D. p.-D. v. angle.	Um. ra.		
110	52	43	153°	67°	19+	♀	(68.1)
78	38	20	157°	63°	.22	♀	(122.1)
104	48	41	160°	76°	.18	♂	(66.1)
105	47	44	154°	....	.21+	♀	(4.1)
108	45	38	161°	....	.21	♂	(69.1)

This species is distributed over the Mississippi drainage and the Gulf drainage from Florida west into Mexico. It is common in all the Kansas drainage systems, but most abundant in the Kansas basin. Its western reported range in the state is Kingman (Call), in the Arkansas drainage, and Wildcat creek, Riley county (Popenoe). It lives preferably in muddy or sandy beds, and is found in rivers and streams of all sizes, often ascending into the smallest tributaries. It is quite active in its movements and is a rapid burrower. In spite of its adaptability to environment, as shown by its wide distribution, *L. anodontoides* is not a hardy species. It is one of the first to die when kept in an aquarium.

This species was among a lot of *Unios* found in the Pleistocene on Hell creek, in Gove county, of this state, by Mr. H. T. Martin, of Kansas University. The specimens turned over to me were typical *anodontoides*, and were in a fair state of preservation. Mr. Martin states that these forms are undoubtedly of Pleistocene and not recent origin, and were found associated with vertebrate remains of Pleistocene fauna.

Anodontoides is quite constant in its characters. The sexual dimorphism, however, is well marked, as in all the higher members of the genus *Lampsilis*, by the post-basal swelling of the female shell. This species is liable to confusion with *L. recta* and still more so with *L. fallaciosa*, to which it is very closely related. A statement of the principal differences will be found in the notes on the latter species.

Lampsilis fallaciosa (SMITH) SIMPSON. Plate LXVI, fig. 1.

Lampsilis fallaciosus Smith, Bull. U. S. Fish Com., 1899, p. 291, pl. LXXXIX; Simpson, Proc. Acad. Nat. Sci. Phila., 1900, p. 74, pl. II, fig. 5.

Shell of moderate size, rather thin, decidedly elongated. General outline similar to that of *L. anodontoides*, but the point of the posterior margin is placed more dorsally. Umboidal ratio, 0.18 to 0.24. Umbones low and somewhat flattened, their sculpture of broad ∧-shaped lines, very pronounced, Umboidal slopes similar to *L. anodontoides* but with a more rounded umboidal ridge Epidermis smooth and shining, a clear yellow, with umbones of an ashy tinge, almost always strikingly rayed with thin bands of grass- or bice-green; the rays often fused to make the posterior umboidal slope solid green. The laterals and pseudocardinals of the same character of *anodontoides* but lighter. Nacre almost always salmon tinted in the shell cavity of the male but generally white in the female, iridescent.

Length.	Weight.	Breadth.	Um. ra.	Dorso-ventral angle.		
88	38	30	0.22+	162°	♂	(121.1)
79	33	28	.23−	160°	♂	(404.1)
81	37	30	.19	155°	♀	(121.1)

This species is found in the upper Mississippi drainage south to Tennessee and Arkansas. There is no doubt that it is also to be found in the other drainage basins of the state, although I have seen specimens of it only from the Kansas drainage. As Call's *anodontoides* includes both *anodontoides* and *fallaciosa*, the later species having been established quite recently, it is impossible to tell anything about the respective range of the two species from his list.

Fallaciosa stands very close to *anodontoides*, and may yet be regarded as a variety of that form. The latter is a heavier, coarser shell, with a more pronounced umboidal ridge, less umboidal sculpture, and a duller color than *fallaciosa*. The relation of the height to the length of the shell of *anodontoides* in a series of Kansas shells was 1 : 1.95; the similar relation in *fallaciosa* was 1 : 2.30. The shell of the latter is much more brilliantly rayed and the female is more produced. Simpson states there is a horny raised ridge on the inside of the mantle behind which is not present in specimens of *anodontoides*.

Lampsilis recta LAMARCK. Plate LXVI, fig. 2.

Unio recta Lamarck. An. sans Vert., VI, 1819, p. 74.

Shell large, thick, thickest anterior to the umbones, elongate, moderately compressed, females produced posteriorly. Anterior margin nearly circular; ventral very slightly bowed, much produced in females; posterior margin pointed at an extremely variable angle; dorsal margin slightly curved and meeting the posterior at an approximate angle of 160 degrees. Umboidal ratio, from 0.16 to 0.22. Umbones small and full, marked with fine concentric ridges. Anterior and lateral slopes rounded. Umboidal ridge prominent and continuously rounded. Posterior umboidal slope narrow and abrupt. Epidermis smooth and shiny, very dark brown to black in adult shells; young shells marked with wide olive-green rays over the entire shell; old shells eradiate. Lines of growth numerous, rounded, continuous. Ligament long, stout, dark brown.

Interior: Pseudocardinals, high, erect, columnar or high pyramidal except for the left posterior, which is often platelike, serrate, double in the left and sometimes in the right, the anterior right when developed sharp and spine-like, the posterior right large; laterals long, high, straight or slightly curved; anterior adductor cicatrix of moderate size and excavation, narrow, fan-shaped, sometimes set slightly under the anterior left pseudocardinal; retractor cicatrix, large and semicircular in outline. Posterior cicatrices of moderate size, lightly impressed, much longer than wide, confluent. Pallial line impressed the anterior half. Dorsal cicatrices a long, narrow pit on the inner surface of the interdentum, often with auxiliary pits in the cavity of the umbones. Nacre variable, white, salmon-pink, rarely purple.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	Angle of posterior point.		
149	66	42	0.28	162°	62°	♂	(164.1)
130	47	34	.18	157°	65°	♂	(120.1)
148	59	42	.21	155°	103°	♀	(65.2)
135	60	44	*.19	152°	54°	♂	(5.1)
142	56	56	.18	163°	60°	♀	(165.3)

L. recta is present all over the Mississippi, the Alabama and the St. Lawrence drainage systems. It is also found in Michigan and the Red River of the North. In Kansas its distribution is peculiar. In the rivers of the southern area it is abundant, and it is also common in the Marais des Cygnes system. In the Kansas system, however, it is confined to the western tributaries; only one specimen has been reported from below Mill creek, in Wabaunsee county, about 120 miles from the juncture of the Kansas with the Missouri river. The one specimen was a fine male and was found in the Wakarusa river, near Lawrence. Above Mill creek the species is fairly common. This peculiar distribution will be discussed in a later paper. *Recta* is not choice of its location, being found either in deep or shallow water and in a gravel or mud bottom.

L. recta is not a variable species, aside from the decided irregularity in the color of the nacre. The shining black epidermis will distinguish it at once from *L. anodontoides* and *L. fallaciosa*, to which it is very closely related. It is a lighter shell than *Unio gibbosus*, which it somewhat resembles in form, and its beak sculpture is entirely different, that of *recta* being made up of fine and numerous loops, while the ridges of *gibbosus* are few and coarse.

Lampsilis subrostrata Say. Plate LXVII, figs. 1, 2.

Unio subrostratus Say, New Harm. Diss., Jan. 15, 1831.

Unio topekaensis Lea, Proc. Acad. Nat. Sci. Phila., XII, 1868, p. 144.

Shell rather small, long ellipsoid, rather thin, females slightly swollen, males somewhat compressed. Anterior margin rather squarely rounded; ventral margin gently bowed, slightly emarginate and produced in females; posterior margin bluntly pointed, decidedly dorsally in female, sharply pointed in male; dorsal margin straight, very slightly oblique, meeting the posterior at an angle of from 150 to 165 degrees. Umboidal ratio, near 0.20. Umbones rather low, directed slightly forward, and heavily marked with a series of broad, slightly curved ∧-shaped ridges, eight to ten in number. Epidermis marked with numerous fine continuous lines of growth, from light brown to dark, rusty brown, the lighter specimens rayed posteriorly with broad bands of green. Ligament light brown, rather long, thin.

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*Not accurate; a broken shell.

Interior: Pseudocardinals double in the left, single and sometimes double in the right valve, variable, generally thin and lamellar, but occasionally pyramidal; erect, finely serrate, left anterior generally twice as long as the left posterior and set on a diagonal parallel to it. Lateral teeth long, thin, slightly curved. Anterior adductor cicatrix well excavated, much longer than wide; retractor cicatrix large and well impressed. Posterior cicatrices variable, large, lightly impressed, confluent. Dorsal muscle scars from one to six, variable in position. Pallial line faint posteriorly but well marked anteriorly. Cavity of beaks shallow, of the shell rather large. Nacre white with considerable iridescence.

Length.	Height.	Breadth.	Um. ra.	Dorso-posterior ventral angle.	Dorsal posterior angle.		
65	31	23	0.18+	60°	161°	♂	(11.1)
64	31	22.5	.21	66°	162°	♀	(40.1)
33	16	8.5	.19+	59°	153°	♂	(9.1)
60	29	21	*	60°	160°	♀	(11.2)
47	23	17	.22	70°	156°	♂	(402.1)

L. subrostrata is found in eastern Texas and as far north as latitude 41 degrees in the Mississippi drainage. In Kansas it is found in all the drainage basins and is fairly common in all of them. The species has been reported as far west as Ellis (Call). *Subrostrata* is a lover of mud beds and quiet waters. It occurs in permanent ponds and lakes as well as streams. In the southern drainage, while quite common in the quiet streams which flow into the larger rivers, it is not common in the rivers themselves. The very characteristic pointed posterior margin will render this an easily identified species. It is interesting to note that Lea, in 1868, described a form of this species from the Kansas river as *Unio topekaensis*.

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* Umbones too worn to determine accurately.

Lampsilis ellipsiformis CONRAD. Plate LXV, fig. 1.

Unio ellipsiformis Conrad, Monog., VIII, 1836, p. 60, pl. XXXIV, fig. 1.
Unio spatulatus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 164.

Shell small, subsolid elliptical, slightly inflated. Anterior margin fully rounded; ventral margin slightly bowed; posterior margin roundly pointed; dorsal margin curved, curving into the dorsal posterior margin. Umboidal ratio, about 0.30. Umbones flattened and ornamented with several coarse, slightly doubly looped ridges. Umboidal slopes flatly rounded, posterior umboidal ridge not sharply marked. Epidermis smooth and shining, yellow with numerous well-marked dark green rays of variable width, wavy posteriorly. Lines of growth coarse, dark, and continuous. Ligament stout and elongate.

Interior: Pseudocardinals ragged, erect, bluntly pointed, double in both valves; teeth of equal size in the left valve, anterior tooth the smaller in the right valve. Laterals short and fairly curved. Interdentum of moderate length, narrow, and rounded. Anterior adductor cicatrix well excavated, of moderate size, semiellipsoid in outline; posterior scars well impressed, large, fused. Dorsal muscle scars few in number, large, placed on the cavity of the beaks. Pallial line distinct for the anterior two-thirds. Cavity of the shell small, of the beaks very slight. Nacre white, silvery posteriorly.

Length.	Height.	Breadth.	Um. ra.		
56	32	18	0.29	♂	210.1
58	32	19.5	.29+	♂	Coll. W. Coll.

L. ellipsiformis occupies the Mississippi valley north of thirty-eight degrees, and also is found in southern Canada and the Red River of the North. In Kansas it has been reported only from the Marais des Cygnes river, but seems fairly well distributed up and down that stream. Its favorite habitat is strictly mud banks. The only species with which this form will be confused is the young of *L. ligamentina*. It has, however, a more elongate and compressed shell than have the young of that species.

Lampsilis parva Barnes. Plate LXVII, fig. 3.

> *Unio parvus* Barnes, Amer. Jour. Sci. and Arts., VI, 1823, pl. XIII, fig. 18.

Shell small, elliptical, thin, inflated. Anterior margin rounded; ventral margin gently bowed; posterior margin rounded; dorsal margin straight, meeting the posterior at an angle of from 140 to 150 degrees. Umbones placed well forward, large and a little inflated, ornamented with five or six coarse concentric ridges. Anterior umboidal slope well rounded, posterior slope less so. Epidermis smooth, generally dull and cloth-like, eradiate, hair brown, with sometimes a greenish cast marginally; umbones often of a lighter shade. Lines of growth numerous, continuous, fine, often darker in color.

Interior: Pseudocardinals double in the left valve and single or double in the right, fine, triangular, erect, the anterior right, when present, small and feeble. Laterals long, straight, thin. Anterior adductor scar well impressed, longer than wide. Posterior cicatrices large, lightly outlined, confluent. Pallial line impressed anteriorly. Dorsal scars few and placed in the cavity of the umbones. Lines of growth show on the inside of the shell as concentric rounded ridges. Cavity of beaks moderately large, of shell large. Nacre white, iridescent.

Length.	Height.	Dorsal posterior angle.	Breadth.		
30	16	16	157	♀	(142.1)
28	16	15	148	♀	(141.1)
18.5	10	6.5	139	♂	(141.2)
22	12	9	145	♂	(141.3)

L. parva ranges from western New York and southern Canada throughout the Mississippi valley to eastern Texas. It is found in all the Kansas drainage systems, and has been reported from as far west as Big creek, at Ellis (Call). It is not an uncommon species in the eastern portion of the Kansas area. Its habitat is muddy and sluggish streams. It burrows several inches into the mud.

This is the smallest species found in Kansas, the average length being about an inch. The females are much more inflated than the males. The small size and heavily undulated beaks will serve at once to identify it. A very near ally of this form, *texasensis*, probably will be found in the southern rivers of the state. It is to be distinguished from *parva* by the more pointed posterior margin.

Lampsilis alata SAY. Plate LXVIII.
Unio alatus Say, Nich. Encyc., II, 1816, pl. IV, fig. 2.

Shell large, subsolid, alate, slightly inflated. Anterior margin rather pointedly rounded; ventral margin straight, slightly bowed; posterior margin straight centrally, rounded at the ends, set at a variable angle with the posterior margin; the upper end of the posterior margin on a level with the umbones. Wing generally high and thin, triangular in outline. Umboidal ratio very variable. Umbones depressed, ornamented with one or two minute concentric ridges. Umboidal slopes flatly rounded. Epidermis smooth but with numerous growth lines, which become imbricated and broken into two or three shallow waves at the base of the wing. Color variable, parrot or sage-green, horn color to chestnut brown or black in old specimens; obscure rays of dark green are present in young specimens.

Interior: Pseudocardinals generally thin, erect, serrate, double in both valves; posterior pseudocardinal the larger in the right valve; in the left valve both teeth of about equal size. Lateral teeth short, gradually becoming higher and thinner, posteriorly straight or very slightly curved. Anterior muscle scars large, striate, deeply impressed. Posterior scars large, wider than long, outlined only, confluent. Pallial line impressed for a short distance anteriorly. Dorsal muscle scars large and shallow, arranged in a diagonal row across the umbone cavity. Cavity of umbones and shell shallow in males, deep in females. Nacre purple, mauve, salmon-pink.

Length.	Height.	Breadth.	Ventral posterior angle.	Um. ra.		
124	75	46	86°	0.24+	♀	(130.1)
115	64	34	105°	.32	♂	(13.1)
137	73	45	110°	.21+	♀	(131.1)
125	70	55	100°	.22+	♀	(135.1)
112	55	35	89°	.18	♂	(12.1)

The general distribution of *L. alata* covers all the Mississippi valley as far south as Arkansas. In Kansas it is not an abundant shell. In the Kansas drainage, the area in which it is most common, the shell has been reported as far west as the Solomon river. It is sometimes found in the Marais des Cygnes, at Melvern, and from there east. It is reported only from the Neosho river and its tributary, Fall river (Popenoe), in the southern drainage. Here it is replaced in the main by *L. purpurata*, which is better fitted to survive the conditions present there. Its habitat is muddy river-beds, in deep water—generally confined to the larger streams.

When in good condition this is one of our most beautiful *Unios*. The variation is confined principally to the color of the epidermis and the nacre. This has been covered in the description above. *Alata* may be confused with two other forms—*L. purpurata* and *lævissima*. From *purpurata* it may be separated in well-preserved specimens by its high wing, but in old specimens this is often almost gone. It is, however, a lighter shell, less swollen, and almost square behind, while *purpurata* is rounded. The pseudocardinals are lighter in *alata*. *Lævissima* is much thinner and more rounded than *alata*, and the pseudocardinals in the former are reduced to a thin erect plate in each valve.

Lampsilis purpurata LAMARCK. Not figured.

Unio purpurata Lamarck, An. sans Vert., VI, 1819, p. 71.
Unio ater Lea, Trans. Amer. Phil. Soc., III, 1830, p. 426, pl. VII, fig. 9.

Shell large, fairly thick, particularly anteriorly and outside of the pallial line, elliptical slightly alate; females inflated, males less so. Anterior margin projecting and decidedly rounded; ventral margin straight, showing a very slight tendency to become emarginate centrally; posterior margin rounded, but tending to become biangulate dorsally; dorsal margin a low, thick wing. Umboidal ratio, 0.15 to 0.30. Umbones large, swollen, rounded, marked in young specimens with a series of five or six V-shaped ridges. Umboidal slopes all fully curved, lateral showing a very faint furrow ventrally; on the posterior slope are two more or less distinct raised lines running from umbone to posterior margin. Epidermis smooth and shiny over and below the umbones, but roughened by the imbrications of the lines of growth marginally. Lines of growth fairly continuous. Epidermis dark brown to black, eradiate in old specimens, obscurely marked with wide, dark green rays in young. Ligament long, light brown, stout.

Interior: Pseudocardinals double in both valves, rather high, very ragged, pyramidal, sometimes directed anteriorly. Laterals of moderate length, thick, high, slightly serrate, a little bowed. Anterior adductor cicatrix ray deeply impressed, large. Posterior cicatrices large, moderately impressed, wider than long, confluent. Pallial line impressed for the first two-thirds of its length. Dorsal cicatrices large, situated in the cavity of the umbones, variable as to number and arrangement. Cavity of umbones moderate, of shell rather deep, particularly in female. Nacre a light pinkish purple, shiny and iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.		
141	72	61	0.22	♀	(324.1)
123	61	46	.18+	♂	(325.1)
121	60	47.5	.21	♀	(324.2)
88	49	44	.28	♀	(325.2)
78	46	34	.26+	♂	(325.3)

L. purpurata is a southern species, ranging as far north as northern Kansas and southern Missouri and from eastern Texas to the Alabama drainage. It is present in all the drainage systems of Kansas, but is most abundant in the southern rivers. It has been found as far west as the Solomon river in the Kansas drainage.

In the Kansas and Marais des Cygnes areas it is fully as common as *L. alata*, its lighter shelled northern ally. Its favorite habitat is deep mud, in three to fifteen feet of water.

Purpurata is not a variable species, although being often attacked by parasites distortions of the shell frequently occur. It probably reaches its maximum size in Kansas waters. Call (4) gives the length of a number of large specimens from the Arkansas river and its tributaries. The length given is from 146 to 169.5 mm. A large male shell from the Blue river, in the Popenoe collection, at Manhattan, has a length of 192 mm. and a height of 121 mm. The only form with which this may be confused is *L. alata*, and the differences between these two species are noted under *L. alata*.

Lampsilis gracilis BARNES. Plate LXVII, fig. 4.

Unio gracilis Barnes, Amer. Jour. of Sci. and Arts, VI, 1823, p. 472.

Shell large, thin, widely elliptical, not inflated, alate, and sometimes bialate. Anterior margin projecting and rounded; ventral margin gently and evenly bowed; posterior margin rounded. Posterior margin winged in young specimens but generally about straight in old ones; anterior wing small and never present in old specimens. Umboidal ratio variable, 0.15 to 0.25. Umbones low and compressed, bearing several coarse, doubly looped ridges, but often worn smooth. Umboidal slopes flatly rounded, the posterior slightly excavated. Epidermis smooth and shiny or dull and cloth-like; color dark straw yellow, marked posteriorly with thin bands of dark green; where cloth-like, dull gray. Lines of growth numerous, continuous, crowded and imbricated posteriorly. Ligament long, fairly stout, dark brown.

Interior: Pseudocardinals weak, degenerate, thin and plate-like, single in each valve, sometimes mere nodules; laterals weak, short, thin, rather curved. Anterior adductor cicatrix lightly impressed, much longer than wide; anterior protractor cicatrix very wide and short, lightly impressed. Posterior cicatrices large, very slightly marked, confluent, wider than long. Pallial line slightly impressed anteriorly. Dorsal cicatrices prominent, about seven in number, arranged diagonally across the umbones. Cavity of the beaks slight, of the shell moderate. Nacre rose or salmon-pink umboidally, shading off into pearl; iridescent over greater part of the shell:

Length.	Height.	Breadth.	Um. ra.		
146	87	46	0.17	♂	(8.1)
120	70	38	.22	♂	(51.1)
121	67	39	.25	♀	(7.1)
103	60	36	.25	♀	(150.1)
106	60	33	.20	♀	(50.1)

L. gracilis has an extended range, being found from eastern Texas to the St. Lawrence, and east in the Hudson river. It is a common species in all river systems of Kansas. Its western range as reported in the Kansas drainage is the Solomon river, and the little Little Arkansas river in the southern drainage. It is often found in the Wakarusa and in the Kansas river near Lawrence. Its habitat is mud and sand-bars, in deep water with little current.

The peculiar bialate character of this shell is lost in old specimens, but it is very striking in young specimens from favored localities. The most variable character is the degenerate pseudocardinals, which may be thin, erect, and knife-like, or else absent but for two pearly nodules. The only species with which this one may be confused is *L. lævissima*. *Lævissima*, however, is much thiner, has a darker nacre and epidermis, and the pseudocardinals are higher and directed obliquely.

Lampsilis lævissima LEA. Not figured.

Symphynota lævissima Lea, Trans. Amer. Phil. Soc., III, 1830, p. 444, pl. XIII, fig. 23.

Shell large, fragile, bialate, rather compressed, broad oval in outline. Anterior margin below the wing strongly curved; ventral margin strongly bowed; posterior margin rounded. Posterior wing high, thin, triangular; anterior wing low, triangular. Umboidal ratio, 0.25 to 0.35. Umbones low, pointed, marked with one or two fine concentric ridges, light gray in color. Anterior umboidal slope almost flat; other slopes quite flatly rounded. Epidermis smooth and shining, varying in color from gray horn to greenish yellow; young specimens almost covered with fine rays. Lines of growth fine, continuous, imbricated posteriorly, and in old specimens marginally, often indicated only by darker color across the disk.

Interior: Pseudocardinals thin, plate-like, rather high, triangular in elevation, set obliquely, single in the left and double in the right valve, the dorsal right being very minute. Laterals of moderate length, slightly curved, high, very thin. Anterior adductor cicatrix large, longer than wide, marked. Protractor cicatrix large, faint. Posterior scars large, very faint, confluent. Pallial line faint. Dorsal muscle scars large, faint, ill defined, arranged in a diagonal row across the cavity of the umbone. Lines of growth show plainly as rounded ridges on the inside of the shell. Nacre salmon to purple-pink and very iridescent.

Length.	Height.	Breadth.	Um. ra.	
131	85	42	0.36+	(328.1)
108	57	30	.26	(327.1)
83	47	26	.29+	(327.2)
183	100	....	.27	(Coll. K. S. A. C.)

L. lævissima is distributed over the Mississippi drainage generally, and from western New York and southern Michigan to eastern Texas. In Kansas it is found in the Kansas river and many of its tributaries, as far west as the junction of the Solomon with the Smoky Hill river, in Dickinson county. It has also been reported from Fall river and the Arkansas in the southern drainage. Its habitat is mud or sand-banks, in quiet water of some depth. The delicate character of the shell and the hinge render it unfit for other conditions.

This is one of the thinnest of the *Unios*. The most striking character of the shell is the peculiar similarity of the pseudocardinals and laterals. When perfect, it is a beautiful shell. The differences from other closely allied forms has been noted under *L. alata* and *L. gracilis*. It is not a variable species.

Lampsilis leptodon Rafinesque. Not figured.

Unio leptodon Rafinesque, Ann. Gen. Sci. Phys. Brux., 1820, p. 295, pl. LXXX.

Symphynota tenuissima Lea, Trans. Amer. Phil. Soc., III, 1829, p. 453, pl. XI, fig. 21.

Shell small, thin, elongate ellipsoid, compressed, connate. Anterior margin an abrupt curve; ventral margin decidedly bowed; posterior margin elongately and roundly pointed; dorsal margin straight. Umboidal slopes very flatly rounded—in fact, almost straight. Umbones placed well forward (umboidal ratio, about 0.18). Umbones much flattened and very small. Epidermis smooth and shining, greenish straw-color, heavily radiate. Lines of growth dark and continuous, but few in number.

Interior: Pseudocardinals degenerate and hardly perceptible in the left valve; single, small, delicate and irregular in the right valve. Lateral teeth long, straight, extremely lamellar, sometimes single in both valves. Anterior adductor cicatrix well impressed, much longer than wide;

posterior scars faint and fused. Pallial line hardly outlined. Cavity of the shell slight; of the beaks, hardly present. Nacre bluish white, iridescent.

L. leptodon inhabits the streams of the northern Mississippi drainage and also occurs in Manitoba (Simpson). It has been found in Kansas only in the Neosho river (Call). It is the most delicate member of the genus and its outward form may confuse it with the anodons but laterals and pseudocardinals are present.

GENUS **OBOVARIA** RAFINESQUE, 1819.

"Shell short, oval, rounded or retuse, solid inflated, thick in front, thinner behind, with high beaks, which are sculptured with very faint, irregular, often broken, and slightly nodulous ridge, which shows a tendency to fall into two loops, the posterior often open behind; epidermis dull, brownish, silky or cloth-like, rarely rayed, rays indistinct; female shell but slightly inflated in the post-basal region, commonly having a shallow furrow or flattened area at the posterior end; pseudocardinals solid, stumpy; laterals short, club-shaped; anterior and posterior cicatrices deep and distinct; nacre bluish white or purple.

"Animal with very short gills, the inner united to the abdominal sac throughout, marsupium projecting far below the rest of the branchiæ and occupying the posterior portion of the outer gills, dolabriform or kidney-shaped; mantle with a wide, thickened, double-edged border, the inner edge of which is often slightly toothed at its post-basal part." (Simpson.)

Obovaria ellipsis LEA. Plate LXIX, fig. 2.

Unio ellipsis Lea, Trans. Amer. Phil. Soc., III, 1828, p. 268, pl. IV, fig. 4.
Unio pearlii Lea, Proc. Acad. Nat. Sci. Phila., I, 1874, p. 191.

Shell of moderate size, short, oval, quite heavy, particularly anteriorly, somewhat inflated. Anterior margin rounded; ventral margin decidedly bowed; posterior margin rounded or roundly pointed dorsally; dorsal margin rather curved, and meeting the posterior at a quite variable angle of from 130 to 160 degrees. Umboidal ratio generally small but very variable; umbones full and swollen, decurved and ornamented with about seven slightly double-looped ridges. Anterior umboidal slope abruptly rounded; posterior slope gradually rounded but flattened somewhat near the posterior margin in the female. Epidermis smooth, often cloth-like, with occasional dark continuous lines of growth, in color from dark horn to honey-brown; young specimens a sage-green and marked with numerous narrow rays of dull green, which are often obscurely present in the adult shell. Ligament rather long, stout, chestnut brown.

Interior: Pseudocardinals heavy, very variable, generally high, erect, columnar or pyramidal, the posterior left often long and lamellar, double in the left and single in the right valve. Laterals of varying length and curvature, coarse and high. Anterior adductor cicatrix of moderate size, deeply excavated, set in front of the pseudocardinals. Posterior scars of moderate size, well impressed, often confluent. Pallial line generally impressed its entire length. Dorsal cicatrices numerous round pits in the cavity of the umbones. Cavity of beaks and shell moderate. Nacre white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
85	55	49	0.12	155°	♀	(21.1)
65	46	32	0.28	140°	♂	(155.1)
83	60	46	0.22	140°	♀	(156.1)
72	50	40	0.23+	144°	♂	(156.2)
42	35	23.5	0.30	148°	♀	(156.3)

O. ellipsis is found in the St. Lawrence drainage, and as far south as Tennessee and Arkansas in the Mississippi drainage. It has been found in all the drainage basins of the state, but it is most common in the Kansas river and its larger tributaries. It is here that, according to Call, it reaches its maximum development. I have seen shells having a length of three and three-fourths inches.

It is a lover of water of moderate depth and of sandy river-beds. Before the great floods of 1903–'04 it could be found in large numbers on the sand-bars near Lawrence. Its strong musculature and smooth shell enable it to move with comparative rapidity, and I have traced its furrow for fifty yards on sand-banks in the Kansas river.

The outline and the umboidal ratio of *ellipsis* are somewhat variable but otherwise it is an extremely constant species. The relation of the height to the length in adult shells averages about as 1 to 1⅓ and there is very little departure from this mean except in young shells, which vary somewhat. The longest shells are males, but the males as a class are no longer than females.

GENUS **PLAGIOLA** (RAFINESQUE, 1819) AGASSIZ.

"Shell triangular ovate, somewhat inflated, solid, with a distinct and often sharp posterior ridge; surface concentrically sculptured; umboidal area somewhat flattened; peaks high, sculptured with delicate, parallel, doubly looped ridges, the anterior rounded, the posterior angular; pseudocardinals ragged; laterals club-shaped, straight or slightly curved; cavity of the beaks moderate, often somewhat compressed; nacre silvery; female shells more or less inflated at the post-basal region.

"Animal with outer gills narrow in front, wide behind; inner gills wide in front, posteriorly free or united to the abdominal sac; marsupium occupying the posterior part of the outer gills, but not extending quite to the hinder end, consisting of well-marked ovisacs which are rounded below; a distinct sulcus extends the whole length of the kidney-shaped marsupium at the inside and outside at some distance above its base; mantle edge thickened and somewhat doubled, in some cases toothed or fringed below." (Simpson.)

Plagiola securis LEA. Plate LXIX, fig. 1.

Unio securis Lea, Trans. Amer. Phil. Soc., III, 1829, p. 437, pl. XI, fig. 17.
Unio lineolatus Conrad, New Fresh-water Shells, 1834, p. 70.

Shell of moderate size, thick, thickest dorso-anteriorly, roundly triangular in outline, much compressed, particularly in the umboidal region. Anterior margin flatly rounded; ventral margin gently bowed; posterior and dorsal margin one gentle and continuous curve. Umboidal ratio, approximately 0.19. Umbones much flattened, pointed, incurved. Anterior umboidal slope flatly rounded; lateral slope almost flat; umboidal ridge sharp and continuous; posterior slope sharply truncated, often at right angles to the lateral slope dorsally. Shell concentrically sculptured with smooth, continuous ridges, which are much crowded on the posterior slope. Epidermis from horn color to deep chestnut brown, and more or less marked with a series of curved rays, rays, which are made up of a series of widely separated dark dots. Ligament short, thick, dark brown.

Interior: Pseudocardinals double in the left and single in right valve, erect, large, pyramidal, coarsely serrate. Laterals of moderate length, curved or almost straight, oblique, heavy, tending to be double in both valves. Interdentum large and smooth, but cut away back of the right pseudocardinal. Muscle cicatrices of moderate size, the two adductor scars of about equal size and excavation. Pallial line well impressed, often its entire length. Dorsal cicatrices a line of pits in the wall of the umbone cavity. Cavity of the umbones moderately large, of the shell slight, that of the female greater than that of the male shell. Nacre milk white, very slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.		
82	53	23	0.20	♂	(147.2)
105	65	42	.19	♂	(36.1)
71	57	34	.18+	♀	(36.2)
76	53	20	.20+	♂	(147.1)

This species is distributed generally over the Mississippi drainage as far south as Louisiana, and is also found in the Tombigbee and Alabama river systems. Its distribution in Kansas is limited to the clear-water rivers of the southern drainage. The exact localities from which it has been reported are: Spring river, Baxer Springs (Cragin); Fall river, Wilson county (Mead and Popenoe); Neosho river, at Oswego (Newlon), and at Burlington and the southern state line. At the last locality it is quite common in the rocky riffles. The species is not confined to riffles, however, but occurs in a variety of locations.

This form shows a decided variation, which is dependent directly on its habitat. In localities where rocks abound and the current is swift the animal develops a strong musculature and a stout, heavy shell. Slow-flowing streams with muddy beds cause the animal to develop a long, light, greatly compressed shell, with a comparatively weak musculature. A comparison of forms from these two different habitats in the same stream are given below:

	Specimens from Neosho river at state line. A	Specimens from Neosho river at Burlington. B
Thickness of shell...............	Very thick..........	Moderately thick.
Color of epidermis..............	Dark chestnut......	Horn color.
Rays.	Distinct.	Indistinct.
Ratio of height to length.......	0.60	0.60 to 0.70
Ratio of breadth to length*.....	Approx. .20	Approx. .40

*This ratio is taken from male shells in both cases.

A complete series of gradations may be found between these two extremes. The dimorphism of this form is indicated by the somewhat greater inflation of the female. There is no other Kansas *Unio* with which this can easily be confused.

Plagiola elegans Lea. Plate LXX, fig. 3.
Unio elegans Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 83, pl. IX, fig. 13.
Unio truncatis Say, Amer. Conch., VI, 1834.

Shell rather small, somewhat thickened anteriorly, thin posteriorly, trigonal, inflated. Anterior margin curved; ventral margin curved, often somewhat emarginate the posterior third; posterior margin pointed, sometimes straight and joining the dorsal margin at a wide angle and sometimes forming a continuous gentle curve with it; dorsal margin short, straight or gently curved oblique. Umboidal ratio, 0.25 to 0.30. Umbones full, elevated, slightly incurved, marked in some cases with a few faint concentric ridges. Anterior umboidal slope fully rounded; lateral slope fully rounded anteriorly and marked by a broad furrow in some cases; posterior umboidal ridge sharp, well defined, and continuous from umbones to margin; posterior slope slightly incurved. Color of the epidermis from grass-green to dark brown, often rayed; rays thin, thread-like, sometimes wavy, crowded. Lines of growth fairly continuous, even, rarely imbricated. Ligament short, dark brown.

Interior: Pseudocardinals erect, very high and sharp pointed, ragged, double in the left and single in the right valve. Laterals rather long, thin, curved. Anterior adductor cicatrix an elongated quadrant, well impressed dorso-posteriorly; posterior cicatrices large, lightly impressed, confluent. Dorsal scars rather large pits in the cavity of the umbones. Pallial line well impressed anteriorly. Cavity of beaks and of the shell considerable. Nacre white, quite iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
54	39	26	0.25	145°	(39.1)
50.5	38	25.5	.30+	149°	(39.2)
44	31	19.5	.28+	152°	(38.1)
46	31	21	.29+	147°	(39.3)
37	24	16	.27	147°	(38.2)

This beautiful little *Unio* has a general range coextensive with that of the preceding member of this genus. Its range in Kansas, however, far exceeds that of *P. securis*, for it is common to all the drainage systems of the state. It has been reported as far west as Wildcat creek, Riley county (Popenoe) in the Kansas drainage, and is found as far west as the Little Arkansas in the southern drainage (Call). Its habitat is the muddy or sandy beds of streams of some size. In my collecting I have never found this form abundant, although present in all good-sized streams. It is often found in the Wakarusa and sometimes in the Kansas river at Lawrence.

The variability of this form is slight and is confined mainly to the color and character of the epidermis. The umboidal ridge is much more prominent in young than in old shells. Its nearest relation, *P. donaciformis*, can be easily identified from *elegans* by the greater length and the finer pseudocardinals of the former. The relation of the height to the length of the shell in *elegans* averages 1 : 1.3. The same relation in *donaciformis* is 1 : 1.8. *P. elegans* can easily be separated from the young of the trigonal *Quadrulas* by its thinner shell and sharp, erect teeth.

Plagiola donaciformis Lea. Plate LXX, figs. 1, 2.

Unio donaciformis Lea, Trans. Amer. Phil. Soc., III, 1827, p. 267, pl. IV, fig. 3.

Unio zig-zag Lea, Trans. Amer. Phil. Soc., III, 1829, p. 440, pl. XII, fig. 19.

Shell small, moderate in thickness, elongate ellipsoid, neither compressed nor inflated. Anterior margin variably curved; ventral margin decidedly bowed; posterior margin roundly or sharply pointed; dorsal margin straight, slightly oblique, and meeting the upper part of the posterior margin at an angle of 150 degrees. Umboidal ratio, 0.30. Umbones rather full, not high, curved inward and downward, with numerous fine concentric ridges, which are sometimes double-looped. Anterior umboidal slope rather flatly rounded; posterior slope sharp near the umbones, but rounded ventrally, slightly excavated. Epidermis smooth, sometimes shiny, marked with numerous fine, fairly continuous lines of growth, in color variable; type A, dirty brown with a greenish cast, marked with numerous dark rays more or less green, conspicuous; type B, light horn, with brown rays made up of V-shaped dashes of dark color directed ventrally; all variations occur between these two; color over umbones generally a lighter shade. Ligament short, thick, dark brown.

Interior: Pseudocardinals double in the left and single in the right valve, high, thin, pointed, the left posterior decidedly curved dorsally. Laterals straight, long, directed ventrally, the dorsal lateral in the left valve often degenerate. Anterior adductor cicatrix much longer than wide, well excavated dorsally; posterior cicatrices small, lightly rarely confluent. Pallial line slightly impressed anteriorly. Dorsal muscle scars often large, in the cavity of the beaks. Cavity of beaks deep, of shell moderate. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.		
63	33	22	0.28	144°	♀	(400.1)
45	22	18	.30	155°	♂	(401.1)
52	30	21.5	.30	150°	♂	(400.2)
38	25	15	.32	157°	♀	(402.1)

P. donaciformis ranges from Michigan south to the Alabama river and to Trinity river, Texas. It is common to all the Kansas drainage systems and abundant in all of them. It does not frequent the smaller streams but seems to be confined to the sandy and muddy beds of rivers. Formerly it was quite common in the eastern portion of the Kansas river.

As a rule there is little variability in either the outline or inflation of this species, but the coloration of the epidermis is subject to great variations. The ground shade may be either light straw, brown, olive-gray, or almost black. The rays when present may be either solid or made up of numerous small V-shaped dark spots, which have given to this form the name of *Unio zig-zag*. All gradations may be found between these different types.

GENUS **TRITOGONIA** AGASSIZ, 1852.

"Shell solid, elongate rhomboid, having a strong irregular posterior ridge, obliquely truncated behind in the male; in the female this region is somewhat compressed and rounded; base incurved; whole surface except rounded wing of the females covered with pustules; beaks low, incurved, and turned forward over the well-developed lunule, which is elongate and filled with epidermal matter; beak sculpture strong, consisting of irregular subparallel ridges which are curved up behind, and fine radiating ridges in front and behind this; epidermis dark olive; hinge plate rather narrow, pseudocardinals strong, ragged; laterals long and straight, near to the pseudocardinals; adductor scars shallow; cavity of the beaks rather deep and compressed; female shell more compressed than that of the male.

"Animal with inner gills much larger than the outer, generally free for the most part from the abdominal sac; palpi enormous, elongate, united to each other behind, and to the mantle a part of their length; mantle thin, with a thickened, dark double border, the inner edge often toothed throughout, the base much thickened at the posterior end and folded at the branchial opening; branchial opening large, with numerous crowded papillæ; anal opening smooth or with only fine dentations; superanal opening long, closed below; in the female there is a thickened flap of the mantle which fills the circular posterior expansion of the shell, and which has a smaller flap inside; foot and abdominal sac large, the latter winged in front." (Simpson.)

Tritogonia tuberculata BARNES. Plate LXX, fig. 4.

Unio tuberculatus Barnes, Amer. Jour. Sci. and Arts, VI, 1823, p. 125, pl. VII, figs. 8*a*, 8*b*.
Unio verricosus Say, Amer. Conch., VI, 1834.

Shell large, solid, elongate, and irregularly trapezoidal. Anterior margin and front third of the ventral margin a gentle curve, middle third of the ventral margin incurved, posterior third of the ventral margin straight or curved somewhat upward; posterior margin somewhat oblique and rounded, straight in males and greatly produced in females; dorsal margin straight or slightly curved and meeting posterior margin at a variable angle. Umboidal ratio variable, from 0.15 to 0.25 Umbones sharp, low, incurved, marked with a number of acute tubercles, which posteriorly form fine lines in some cases. Anterior umboidal slope flatly rounded, lateral slope slightly excavated, both thickly studded with small, low tubercles, which often arrange themselves into diagonal rows. Posterior umboidal ridge very prominent, slightly curved posteriorly; in the males numerous side ridges are given off which run to the posterior margin; this character not well developed in females; posterior slope of male short and truncate, of female developed ventrally into a long, smooth wing. Epidermis from rusty chestnut brown to dark horn color, with sometimes a greenish tinge. Lines of growth coarse, but not continuous. Ligament long, dark brown. Lunule large, black.

Interior: Pseudocardinals large, pyramidal, ragged, double in the left, single and sometimes double in the right. Laterals long, straight, rather heavy. Anterior adductor cicatrix deep, and sometimes set slightly under the anterior pseudocardinal; retractor cicatrix small and well impressed. Posterior scars well marked, of moderate size, fused. Dorsal cicatrices small. Pallial line impressed and crenulate anteriorly. Cavity of beaks deep, of the shell moderate. Nacre milk-white, iridescent posteriorly.

Length.	Height.	Bredth.	Um. ra.		
168	81	47	0.19	♀	(215.1)
159	74	39	.17+	♀	(215.2)
118.5	67	33.5	.23+	♂	(28.1)
118	63	34	.19—	♂	(37.1)
123	60	32	.16+	♀	(37.2)

T. tuberculata is found throughout the Mississippi drainage and in those streams emptying into the Gulf from Alabama to Texas. Its distribution in Kansas is general. Its reported western range in the southern drainage is the Little Arkansas river at Wichita (Mead). In the Kansas drainage it has been found as far west as the Smoky Hill river at Salina. It doubtless ranges somewhat further westward. The largest specimens I have seen from Kansas waters were two females from the latter locality. Their measurements are given in the table above (215.1 and 215.2).

There seems to be no definite habitat for this species. It is found in almost all locations except sandy, shifting river-beds. In the Wakarusa river at Lawrence, where it is a common species, it is found well rooted in the gravel and shingle in a swift current, and again buried to the siphons in the thick black mud, where there is but little current, in company with *Symphynota complanata* and *Strophitus edentulus*. I have found specimens in Indian creek, in Johnson county, lying on a hard rock bottom in six inches of rapidly flowing water.

This is one of the easiest species in which to distinguish the sexes. The males are short, thick, and abruptly truncate posteriorly; the females long, slender, and provided with the posterior wing. There is great variation in the number and position of the pustules. This is one of the easiest of Kansas *Unios* to identify.

MESOGENÆ.

"Male and female shells alike, short, solid, inflated, embryo occupying a few distinct ovisacs in the center of the outer gills." (Simpson.)

GENUS **CYPROGENIA** AGASSIZ, 1852.

"Shell solid, inflated, rounded triangular, sometimes slightly retuse, generally a little biangulate behind; posterior ridge unusually well developed, especially in the young shell; umboidal region flattened parallel with the axis of the shell, sometimes compressed; beaks turned inward and forward, the sculpture very faint, consisting of slightly doubly looped ridges; sculpture of the shell nodular, radially wrinkled or lachrymose; ligament black and conspicuous; lunule distinct and well developed; epidermis shining, painted with a delicate dark mottling on a light ground; hinge plate wide and flat; pseudocardinals heavy, triangular, blunt, ragged; laterals short, obliquely striated; cavity of beaks not deep; adductor scars small, well impressed, those at the posterior round; nacre bright and silvery.

"Animal with inner gills partly free from the abdominal sac, rounded below outer gills, smaller marsupium consisting of from seven to twenty-three very long purple ovisacs pendant from the central base of the outer gills and formed into a close coil with the ends turned inwardly; branchial opening large, with many small papillæ; anal opening smooth." (Simpson.)

Cyprogenia alberti CONRAD. Plate LXXI, fig. 2.

Unio alberti Conrad, Proc. Acad. Nat. Sci. Phila., 1854, p. 295, pl. XXXVI, fig. 1.
Unio lamarcianus Lea, Trans. Amer. Phil. Soc., X, 1852, p. 236, pl. XVII, fig. 20.
Unio popenoi Call, Bull. Washb. Coll., I, 1885, p. 48, pl. II.

Shell moderately large, very roundly triangular, compressed, solid, thickest anteriorly. Anterior margin irregularly rounded; posterior margin gently curved, emarginate posteriorly; posterior margin short, slightly emarginate centrally; dorsal margin long, oblique, curved. Umboidal ratio, 0.20 to 0.40. Umbones triangular, flat but fairly high, pointed, plainly marked with the high but rounded umboidal ridge, directed slightly forward. Anterior umboidal slope fully rounded, lateral slope bearing a shallow but distinct furrow; posterior umboidal ridge high, distinct, spreading out ventrally and rounded on both sides; posterior slope slightly excavated; the umboidal third of the shell much compressed. Shell sculpture consisting of several rounded, concentric ridges toward the center of the disk and a series of fine diagonal furrows above them in the lateral furrow. Epidermis straw yellow with wide, dark rays of green, which are curved forward, the spaces between the rays dotted with minute triangular dots of green, which arrange themselves at times into fine lines. Ligament long, thin, dark brown.

Interior: Pseudocardinals fairly large, erect, pointed, ragged, double in the left and single in the right valve. Laterals short, low, heavy, straight, very oblique; interdentum long, broad, and smooth. Anterior adductor cicatrix rather small, located in front of the pseudocardinals, much longer than wide, well excavated. Posterior cicatrices small, well impressed, distinct. Dorsal cicatrices forming a line on the under surface of the interdentum. Pallial line impressed only anteriorly. Hardly any beak cavity; cavity of the shell small. Nacre a beautiful white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
74	64	37	0.36	(Coll. K. S. A. C.)
76	64	36	.21	(Coll. Kan. Acd. Sci.)
61	53	30	.30	
77	62	40	.25	
65	51	24	.31	

C. alberti is limited in range to southern Kansas, Missouri, Indian Territory, and Arkansas. Its distribution in Kansas is limited to the clear-water streams of the southern drainage. The streams in which it has been found are Fall river (Mead, Popenoe), Verdigris river (Cragin, Popenoe), and Neosho river (Fenis). Even in these streams it is a rare species.

As compared with specimens before me from the White river, Arkansas, the Kansas form is a much larger, more inflated and massive shell, with smaller muscle cicatrices. Doctor Call described specimens from the Neosho and Verdigris rivers as a new species (*Unio popenoi*), but later on worked out the synonomy and placed it under *U. alberti* (5–6).

There is no other *Unio* in Kansas which can be confused with this one. The peculiar markings of the epidermis and the extreme flattening of the beaks for about one-third the distance vertically across the disk is very characteristic.

GENUS **OBLIQUARIA** (RAFINESQUE, 1820) SIMPSON.

"Shell inflated, solid, oval, ending in tolerably sharp point behind, having a row of large compressed longitudinal knobs running off from the beaks to the center of the base, those on one valve alternating in position with the knobs of the other, and a well-developed posterior ridge, the space between the ridge and the knobs somewhat excavated; posterior slope and sometimes the whole shell more or less corrugately sculptured; beaks prominent, incurved, and pointed slightly forward towards a tolerably well-developed lunule; beak sculpture strong, consisting of four or five heavy, parallel ridges, which fall low in front but are curved up behind; epidermis smooth, generally shining, painted with numerous delicate, wavy, darker, broken rays; pseudocardinals strong, direct, and ragged; laterals short, nearly straight; anterior muscle scars small, sides of the pit smooth, bottom ragged; front part of shell very solid, suddenly becoming rather thin just behind the knobs; male and female shells essentially alike.

'Animal with small branchiæ, rounded below, inner the larger, free from the abdominal sac in part; marsupium of a few distinctly marked ovisacs (4 to 7), occupying a position just behind the center of the outer gills, projecting far below the rest of the branchiæ, their bases rounded; mantle cut away at the thinner portion of the shell; anal opening smooth or having only minute crenulations." (Simpson.)

Obliquaria reflexa Rafinesque. Plate LXXI, fig. 1.

Obliquaria reflexa Rafinesque, Ann. Gen. Sci. Phys., 1820, p. 306.

Unio cornutus Barnes, Amer. Jour. Sci. and Arts, vi, 1823, p. 122, pl. iv, figs. 5, 5*a*, 5*b*, 5*c*.

Shell rather small, inflated, thick anteriorly, of only moderate thickness posteriorly, outline variable, wide or narrow, ovate, pointed posteriorly. Anterior margin and anterior half of ventral margin forming a semicircular curve, posterior position of ventral margin curved or straight, sometimes slightly emarginate; posterior margin short, commonly joining the dorsal margin at an angle of from 130 to 145 degrees but sometimes forming a common curve with it. Umboidal ratio, one-fourth to one-third. Umbones large and full, incurved, marked with several heavy ridges. Anterior umboidal slope fully rounded; lateral slope ornamented with a series (generally four) of large, prominent knobs, which are located in a slightly curved line and are about twice their diameter apart, the area between them slightly excavated; knobs alternating with each other on the opposite valves; posterior to the knobs a very shallow furrow is generally present. Umboidal ridge permanent, continuous, rounded; posterior slope slightly excavated, ornamented with small, obscure, transverse ridges. Epidermis smooth; in color brown, color sometimes arranged in concentric bands of lighter and darker shades, frequently rayed with obscure, narrow, wavy lines of dark green. Lines of growth rounded and continuous, often dark colored. Ligament short, thick, dark brown; lunule small but well marked.

Interior: Pseudocardinals large, ragged, pyramidal, double in the left and single in the right valve, the right tooth surrounded by a trench in which the left pseudocardinals lock. Laterals low, thick, short, slightly curved. Anterior adductor cicatrix small, well excavated, long and narrow, the floor roughened; posterior scars rather small, well impressed, distinct. Pallial line impressed for anterior half. Dorsal cicatrices forming a line on the base of the pseudocardinals. Cavity of beaks variable, generally small, of the shell small. Nacre silver white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	Number of nodules.	
56	50	32	0.30	132°	4–5	(23.1)
48	34.5	23.5	.30	131°	4–4	(34.1)
62	49	36.5	.27+	Curved.	4–4	(22.1)
58	45	27.5	.29	144°	4–3	(22.4)
42.5	29	18	.26+	Curved.	3–	(326.1)

This species ranges from Michigan south and southwest to Alabama and central Texas. In Kansas it is found in the clear-water rivers of the southern drainage and in them is an occasional but not a common species. Only one specimen has been found in the Marais des Cygnes drainage. This was a single valve from the Marais des Cygnes at Ottawa. Cragin similarly reports a single specimen from the Kansas drainage, found at Mill creek, in Wabaunsee county. The favorite habitat is gravel-beds. No species is more distinct than this one. It can be distinguished from any other Kansas *Unio* without difficulty by the prominent lateral knobs alone. There is comparatively little variation.

PTYCHOGENÆ.

"Male and female shells essentially alike; embryos contained in distinct ovisacs with rounded bases, occupying the entire outer gills, which, when gravid, consist of a series of folds." (Simpson.)

GENUS **PTYCHOBRANCHUS** SIMPSON, 1900.

"Shell triangular, solid, sometimes becoming arcuate in old specimens; umboidal region rather elevated; beak sculpture consisting of faint, somewhat broken ridges, which have a tendency to be doubly looped; posterior ridge round but well developed; epidermis usually painted with wavy hairline rays or broken radiating bars, which show a tendency to form square spots; hinge plate rather wide and flat; pseudocardinals small, low, triangular, and roughened; laterals club-shaped, remote; cavity of the beaks shallow; muscle scars rather deep.

"Animal with inner gills free all or part of their length from the abdominal sac; marsupium occupying the basal half of the whole length of the outer gills and hanging in from six to twenty beautiful folds; ovisacs distinct, each ending below in an enlarged, rounded bulb with a colored spot in its center; mantle thin, with a dark, thickened border; branchial opening large, with very minute papillæ or crenulations, sometimes smooth; anal opening crenulate or smooth." (Simpson.)

Ptychobranchus phaseolus HILDRETH. Plate LXXII, fig. 2.

Unio phaseolus Hildreth, Amer. Jour. Sci. and Arts, XIV, 1828, p. 283.
Unio planulatus Lea, Trans. Amer. Phil Soc., III, 1830, p. 431, pl. IX, fig. 13.
Unio camelus Lea, Trans. Amer. Phil. Soc., V, 1834, p. 102, pl. XV, fig. 45.

Shell of moderate to large size, compressed, elongate ellipsoid in the outline, very heavy. Anterior margin very decidedly rounded; ventral margin gently bowed or straight; posterior margin roundly pointed, the point being directed ventrally; dorsal margin oblique and curved, generally passing gradually into the posterior margin. Umboidal ratio, about 0.25. Umbones low and compressed, marked with a number of very fine undulating ridges. Umboidal slopes flattened dorsally but decidedly curved marginally. Posterior umboidal ridge prominent but rounded. Epidermis light horn color (often with an olive-green cast) to dark chestnut-brown. Rays either fine, dark, and wavy, or broad and interrupted. Lines of growth numerous, coarse, and often imbricated. Lunule large and elongate. Ligament short and stout.

Interior: Pseudocardinals small, low, serrate, bluntly pyramidal, single in the right and double in the left valve. Laterals short, heavy, slightly curved, oblique. Interdentum quite long, smooth, broad. Anterior adductor cicatrix deeply pitted, elongate, placed in front of the pseudocardinals. Posterior scars deeply impresssd and distinct, the retractor almost hidden, and placed in on the tip of the lateral tooth; adductor scar elongate and pointed posteriorly. Dorsal muscle scar large and well impressed on the lower surface of the interdentum. Pallial line impressed its entire length. Branchial area well impressed, cavity of shell small. Beaks practically without a cavity. Nacre milk-white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
79	42	25	0.28	(311.2)
98	55	34	.23	(350.1)
82	45	34	.23	(311.1)
87	46	29	.20	(311.3)

The range of this species is throughout the southern portion of the Mississippi valley, the Ohio river drainage, and the peninsula of Michigan. In Kansas it is found quite commonly in the clear-water rivers of the southern drainage, particularly in the smaller streams. One specimen has been reported by Call from the Wakarusa river, but careful collecting along that stream at intervals during the last five years has failed to bring to light any more specimens. In the southern rivers of the state the shell reaches unusual size, some specimens in the State Agricultural College, collected by Professor Popenoe, have a length of over 110 mm.

This form varies much in shape, and often presents a humped appearance, which has led to its description as a separate species. There are, however, all gradations between this form and the typical one. This species may be confused with *P. clintonense* (given below) and with *Unio gibbosus*. The beak sculpture of the form under discussion consists of numerous fine ridges, while the umbone ridges of *U. gibbosus* are few and extremely coarse. However, owing to the peculiarly soft character of the shell substance, the beaks of *phaseolus* are almost always much worn. The epidermis of *phaseolus* is lighter and more cloth-like in texture than that of *gibbosus*, and the adult *gibbosus* is eradiate. The lateral teeth of *gibbosus* are longer than those of *phaseolus*.

Ptychobranchus clintonense SIMPSON. Not figured.

Ptychobranchus clintonensis Simpson, Proc. Acad. Nat. Sci. Phila., 1900, pt. 1, p. 79, pl. 5, fig. 3.

"Shell elongate, elliptical, sometimes slightly obovate, feebly biangulate behind, quite solid, beak sculpture not seen; epidermis somewhat cloth-like, dirty olive, the hinder two-thirds of the shell ornamented with delicate, wavy, capillary rays; pseudocardinals low, laterals very heavy, remote; muscle scars large and well defined; nacre lurid, with greenish-brown blotches. Length, 73; height, 40; breadth, 22." (Simpson.)

This species is described by Simpson from the Little Red river near Clinton, Ark. I have a number of specimens from Spring river at Baxter Springs which will probably fall under this species, but until there is more material in better condition at hand for identification I list this species for the state as doubtful. It is quite close to the preceding one.

DIAGENÆ.

"Male and female shells alike; embryos contained in the outer gills in short ovisacs, which run crosswise of the branchiæ, and are discharged entire into the water." (Simpson.)

GENUS **STROPHITUS** RAFINESQUE, 1820.

"Shell elliptical to rhomboid, inflated, subsolid, pointed or biangulate behind, with a low posterior ridge which is sometimes double; beaks full, sculpture consisting of a few strong concentric ridges which curve sharply upward behind; epidermis rayed or rayless, shining; hinge line incurved in front of the beaks; teeth rudimentary, a vestigeal, compressed tooth in each valve, and sometimes a secondary tooth ; laterals rarely present ; muscle scars shallow.

"Animal with the marsupium occupying the whole of the outer gills, consisting of short, horizontal ovisacs, which run directly across the gills, and are discharged through the outer wall with the ovules in them ; ovules ten to twenty-five in each ovisac and arranged in one or two rows, inner gills the larger, free in part from the abdominal sac, or wholly united ; mantle generally bordered behind with square black spots ; branchial opening with numerous papillæ ; opening papillose or crenulate." (Simpson.)

Strophitus edentulus SAY. Plate LXXII, fig. 1.

Alasmodonta edentula Say, New Harm. Diss., II, No. 22, 1829, p. 340.
Anodonta wardiana Lea, Trans. Amer. Phil. Soc., IV, 1836, p. 46, pl. XIV, fig. 42.
Anodonta arkansasensis Lea, Trans. Amer. Phil. Soc., XI, 1852, p. 293, pl. XXIX, fig. 56.

Shell moderate to large, rather thin, but variable in this respect, slightly thickened anteriorly, long elliptical, not much inflated. Anterior margin rounded ; ventral margin somewhat bowed ; posterior margin roundly triangulate, the point of juncture of the two posterior margins being exceedingly variable in its position ; dorsal margin straight, and joined with the posterior at a very greatly varying angle. Umboidal ratio approximately one-third of the entire length, and quite constant. Umbones fairly prominent, but not much raised, and ornamented with three or four coarse ridges. Lines of growth quite continuous and very variable in their prominence. Color of epidermis varies from light horn to almost black ; young specimens marked with dark green rays, old shells eradiate. Ligament stout, almost black.

Interior : Pseudocardinals represented by one or two pearly nodules below or anterior to the umbones, hinge ridge rather heavy. Anterior muscle scars well marked ; anterior adductor cicatrix sometimes slightly impressed ; posterior scars small but well marked, often fused. Pallial line hardly apparent ; prominent lines of growth show on interior surface as slight rounded ridges. Cavity of shell moderately deep, of umbones shallow. Nacre variable, sometimes silver-white; cavity of the shell often salmon-yellow, varying to salmon-rose; posterior and lower margins of the shell iridescent.

Length.	Height.	Breadth.	Um. ra.	
100	58	34	0.33	(161.1)
62	43	27.5	.37	(160.1)
81	44	30	.33	(160.2)
56	29	18	.35+	(160.3)
67.5	35	23	.33	(160.4)

This species is found throughout the Mississippi and St. Lawrence drainage areas and in eastern Texas. In Kansas it is common to all the drainage basins. It has been reported as far west as Reno county (Mead) in the southern drainage, and as the Smoky Hill river at Salina in the western drainage. In the streams and small rivers of the east central part of the state it is quite abundant. Although preferring a muddy bottom and quiet water, it is able, by anchoring itself in the silt with its muscular foot, to withstand a strong current. It is a rapid burrower and quite tenacious of life.

There is but little variation in this form while it remains in quiet, muddy streams, but rapid flowing and rocky streams produce a variety of forms and colors in the shell, any of which would be sufficient to characterize a species were they constant.

The peculiar rudiments of pseudocardinals will serve to separate this species from any other in the state.

HOMOGENÆ.

"Male and female shells alike, oval to elongate; beak sculpture coarse; embryos filling the entire gills in the form of thick, smooth pads; the ovisacs not separated by sulci." (Simpson.)

GENUS **ANODONTA** LAMARCK, 1799.

"Shell elliptical, thin, inflated, often slightly winged posteriorly; beak sculpture consisting of rather numerous more or less parallel ridges, usually somewhat doubly looped, and becoming slightly nodulous on the loops; surface generally smooth, shining; hinge edentulous, reduced to a mere line, regularly curved; muscle scars rather faint; nacre dull.

"Animal with the marsupium occupying the whole outer gills, when filled forming a smooth, very thick, liver-colored pad; gills free from the abdominal sac from one-half to their entire length; palpi generally large; branchial opening papillose; anal opening without papillæ, though sometimes very slightly crenulate; superanal opening generally small, widely separated from the anal." (Simpson.)

Anodonta imbecillis Say. Plate LXXIV, fig. 1.
Anodonta imbecillis Say, New Harm. Diss., II, No. 23, 1829, p. 355.
Anodonta incerta Lea, Trans. Amer. Phil. Soc., V, 1834, p. 46, pl. VI, fig. 16.

Shell moderate in size, very thin, elliptical, inflated. Anterior margin rounded; ventral margin bowed, sometimes slightly produced posteriorly; posterior margin roundly pointed, point variable in length and sometimes turned slightly upward; dorsal margin straight, variable in length, dorsal posterior angle from 145 to 150 degrees. There is a tendency to form a dorsal wing. Umboidal ratio, approximately 0.30; umbones extremely small and flat, marked by several fine broken ridges concentrically arranged. Anterior and lateral slopes rounded; posterior slope somewhat excavated. Lines of growth continuous, dark in color, infrequent. Epidermis smooth and polished, bottle-green to pea-green in color, the umbones a light horn-brown; postumboidal slope often dark brown, disk often marked with dark green rays. Ligament slight, long.

Interior: Muscle scars slightly marked, anterior ones the more so; pallial line sometimes marked. Cavity of shell large of beaks practically none. Nacre silver-white, iridescent over the entire cavity.

Length.	Height.	Breadth.	Dorsal posterior angle.	Um. ra.	
74	34	27.5	153°	0.30	(33.1)
77	36	30	154°	.31	(33.3)
53	26	19	145°	.30	(31.1)
63	31	24.5	145°	.29+	(33.4)
62.5	26.5	24	151°	.29	(33.6)

A. imbecillis has a general distribution in all the Mississippi valley, Texas, North and South Carolina. It is found in all the Kansas drainage areas and is plentiful in favored stations in all of them. It is reported by Call as far west as Reno county in the southern drainage area, and I have received specimens from as far west as Hays, from Big creek, a tributary of the Smoky Hill river, in the Kansas drainage. The largest specimens that I have seen from the state were from Rock creek, Douglas county. This species is a lover of quiet water and muddy or somewhat sandy banks. It is in fact unfitted to survive other conditions on account of its fragile shell.

There is no species with which this form can be easily confused; the extreme fragileness of the shell and lack of umbones will distinguish it from the young of *A. grandis*. It varies but little.

Anodonta suborbiculata Say. Plate LXXIII.

Anodonta suborbiculata Say, New Harm. Diss. (newspaper form), Jan. 29, 1831.

Shell very large, thin, slightly compressed, suborbiculate in outline. Anterior margin flatly curved; ventral margin almost circular; posterior margin rounded for the first fifth ventrally, and very slightly incurved for the remaining four-fifths; dorsal margin straight or very slightly curved. Umboidal ratio variable, from 0.25 to 0.40. Umbones very low and flat, and ornamented with four or five pairs of slight nodules arranged in a series which represent degenerate double-looped ridges. Anterior and lateral umboidal slopes flatly curved; posterior umboidal ridge low but distinct; posterior slope slightly excavated. Epidermis straw-yellow to dark brown in color, smooth and shining except for the posterior umboidal slope, which is slightly roughened; fine green rays are sometimes present. Lines of growth fine and continuous. Ligament dark and rather stout.

Interior: Hinge line very thin. Muscle scars large, very faint. Pallial line very faint. Cavity of shell rather large, of beaks very slight. Nacre white, varying to a light salmon, deepest in color near the umbones, very iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
176	133	58	0.26+	140°	(Coll. Kan. Acad. Sci.)
135	98	44	.40	125°	
72	58	18	.32	110°	(Coll. W. C.)

This species extends from Nebraska and Illinois south to

Louisiana (Simpson). It is generally a rare species, but sometimes abundant locally (Call). It has been reported from only two localities in the state, the Neosho river in the southern drainage (Call), and Silver Lake, Shawnee county, in the Kansas drainage. Its habitat is the muddy beds of slow streams and ponds.

This is the largest anodon found in the state. The largest specimen I have seen from the state measured 176 mm. in length. It is in the Quintard collection of the Kansas Academy of Science, at Topeka. There is but little variation. The juvenile shells are much more rayed than are the adult, and the dorsal posterior angle grows less acute as the shell increases in size and age.

Anodonta grandis SAY. Plate LXXIV, fig. 3.

Anodonta grandis Say, New Harm. Diss., II, 1829, p. 341.
Anodonta ovata Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 2, pl. II, fig. 2.
Anodonta salmonia Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 45, pl. XIV, fig. 41.
Anodonta lewisii Lea, Proc. Acad. Nat. Sci. Phila., I, 1857, p. 84.

Shell large, moderately thin, inflated, wide elliptical. Anterior margin rounded; ventral margin generally gently bowed but sometimes almost straight; posterior margin bluntly angulate or rounded; dorsal margin straight or slightly curved and extremely variable in its length, the dorsal posterior angle quite variable. Umboidal ratio quite constant, at approximately one third. Umbones more or less inflated and marked with three or four coarse double-looped ridges. Umboidal slopes rounded, the posterior and anterior slope flattened near their margins. Epidermis smooth, shining, variable in color, generally green over the disk and brownish gray on the umbones, and the posterior slope almost black, the color often arranged in concentric bands of different shades; large old specimens are often black, young specimens obscurely rayed. Ligament moderately long, stout, very dark brown. Posterior hinge line slightly curved and well defined. Muscle cicatrices large, rather faintly outlined. Pallial line not visible in some specimens and never impressed. Dorsal muscle scars occasionally impressed, but often faint, located in the wall of the tip of the umbone cavity. Umboidal cavity small, cavity of shell large.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
124	72	46	0.30	156°	(27.1)
135	77	49	.28+	Rounded.	(56.1)
122	70	38	.32	154°	(25.1)
103	57	37	.31	151°	(57.1)
97	55	31	.31+	146°	(26.1)

A. grandis and its varieties range from the upper St. Lawrence and Lake Winnipeg southwest through the Mississippi drainage to Texas. It is our commonest and one of our largest anodons, and is well distributed over all the Kansas drainage areas. Its favorite habitat is the muddy beds of permanent ponds and lakes and slow-flowing streams. Sometimes, however, the species becomes established in large, rapidly flowing, but not rocky streams. It is abundant in the lakes formed from old river-beds of the Missouri river along the northern part of the east boundary of the state, but it is not present in similar bodies of water along the Kansas river near Lawrence.

This is one of the most variable of Anodons, and is possessed of an extensive synonymy on that account. The relation of the height to the length and the umboidal ratio are fairly constant, but the shell varies in almost every character. There is much difference in the thickness of the shell, due to the station, and whole colonies will be found where the epidermis is a rusty black instead of the typical shiny green. There have been numerous varieties of this species described, and the form called var. *gigantea* is present in Kansas waters, but I think the series of intermediates is so complete that it does not merit even the distinction of a variety. I regard the *A. bealii* reported from this state as a synonym of *grandis*.

Anodonta danielsii Lea. Not figured.

Anodonta danielsii Lea, Proc. Acad. Nat. Sci. Phila., II, 1858, p. 139.

Shell long, thin, elongate elliptical, slightly inflated. Anterior margin rounded; ventral margin gently bowed; posterior margin roundly pointed; dorsal margin straight or slightly curved, and meeting the posterior margin at an angle of about 155 degrees. Umboidal ratio, approximately 0.28. Umbones prominent but not inflated, and sculptured with two or three sets of rather small, deep, double loops. Umboidal slopes gently rounded. Epidermis smooth and polished, seal- to olive-brown, the umbones light brownish drab; posterior umboidal slope roughened and very dark brown or black. Eradiate or showing the slightest traces of rays. Lines of growth continuous and imbricated marginally.

Interior: Hinge line slightly thickened; anterior scars lightly impressed, large, often fused. Posterior scars faintly marked, large, confluent. Pallial line sometimes marked. Cavity of the beaks and shell deep. Nacre silver-white and iridescent.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
130	68	47	0.27–	154°	(220.1)
116	61	35	.28+	156°	(217.1)
100	53	34.5	.275	153°	(216.1)
86	41	36	.29	154°	(30.1)

This species is confined to the rivers of Kansas and Indian Territory. In Kansas it has been reported from twenty localities, scattered all over the state and in all the drainage areas. Its reported western range is Big creek, in Ellis county (Call). The largest specimens I have seen are from the Smoky Hill river at Salina. This species is not rare in any of the drainage areas.

The relation of the height to the length, the umboidal ratio and the dorsal posterior marginal angle are all remarkably constant in the series which I have examined. It is a slenderer species than *A. grandis*, and is more cylindrical and less pointed posteriorly. The color of the epidermis is quite different from that of the typical *grandis*. The specimens reported by Call as *A. dejecta* are without doubt this species.

Anodonta opaca Lea. Plate LXXV.

Anodonta opaca Lea, Trans. Amer. Phil. Soc., x, 1852, p. 285, pl. xxv, fig. 46.

Shell large, thin, broadly elliptical, inflated. Anterior margin rounded; ventral margin straight or slightly bowed; posterior margin roundly biangulate, the dorsal half sometimes slightly incurved. Umboidal ratio, two-fifths of the entire length of the shell. Umbones large, high, and much inflated, marked with several concentric, nodulous, double-looped ridges. Anterior and lateral umboidal slopes abruptly curved; posterior slope abrupt and often slightly incurved. Epidermis smooth and shining, yellow, with a light green cast, obscurely marked with numerous fine greenish rays, which extend over the anterior and lateral slopes; the umbones often of an olive-gray color. Lines of growth prominent, raised, but smooth anteriorly, imbricated posteriorly. Ligament long, fairly stout, of a light brown color.

Interior: Hinge line gently bowed. Muscle scars large and faint; the anterior scars of almost equal size, and distinct; the posterior scars confluent. Pallial line hardly visible, wavy. Cavity of shell large, of umbones very large. Nacre silvery or pinkish, moderately iridescent.

Length.	Height.	Breadth.	Um. ra.	
119	82	54	42	(Coll. W. C.)

A. opaca is a Southern species. Its range is from Louisiana and Mississippi north to Kansas. I know of only one locality for this form in Kansas: Quimbly creek, in Clay county, a small tributary of the Kansas drainage. Doubtless it also occurs in the southern series of the state.

This form can hardly be confused with any other Anodon. It resembles *A. grandis* in coloring and slightly in outline, but the ratio of the height to the length in *grandis* is as 1 to 2, while in the form under discussion it is as 2 to 3. The high and extremely full beaks are very characteristic.

GENUS **ANODONTOIDES** SIMPSON.

"Shell elliptical, inflated, thin, with a faint posterior ridge, sometimes constricted at the center of the base; beaks rather full, with a few coarse, subparallel, concentric ridges, which are curved up rather suddenly behind, and back of these are some fine radiating ridges; epidermis smooth, shining, often rayed; hinge line slightly incurved in front of the beaks, edentulous or bearing the merest rudiments of teeth; muscle scars shallow, irregular; nacre bluish white.

"Animal with the marsupium occupying the outer and sometimes the four leaves of the branchiæ; ovules more numerous in the outer, the whole pad-like; gills large, inner semicircular, free from the abdominal sac or united to it; branchial opening large, with many small papillæ; anal opening with well-developed papillæ." (Simpson.)

Anodontoides ferussacianus Lea. Plate LXXIV, fig. 2.

Anodontoides ferussacianus Lea, Trans. Amer. Phil. Soc., v, 1834, p. 45, pl. vi, fig. 15.

Shell of moderate size, elliptical, narrowing posteriorly, thin, slightly inflated. Anterior margin fully rounded; ventral decidedly bowed, sometimes a little incurved centrally; posterior margin roundly pointed, dorsal margin straight to slightly curved. Umbones of moderate height and inflation, and ornamented with several ridges, which are bluntly pointed posteriorly. Anterior and lateral umboidal slopes fully rounded; posterior slope often slightly excavated near the dorsal margin. Epidermis smooth and shining, of dark olive-green or brown, lightest over the umbones, and often ornamented with wide, rather obscure dark green rays. Lines of growth dark and continuous, but not generally imbricated or roughened. Ligament weak and light brown in color.

Interior: Hinge line slightly thickened, slightly incurved in front of the beaks, and sometimes showing a slight rudiment of a pseudocardinal. Muscle scars fairly well outlined, large, the anterior scars distinct, the posterior scars confluent. Pallial line outlined for its entire length. Cavity of the shell large, of the beaks slight. Nacre white or bluish, slightly iridescent.

Length.	Height.	Breadth.	Um. ra.	
75	37	22	0.30	(Coll. W. C.)

This species is found throughout the Mississippi drainage and in a number of rivers of eastern Canada. In Kansas it has been reported only from the northern or Kansas drainage. In this area we have a series of reports extending from the eastern boundary of the state west to Sappa creek, near Oberlin. Call (5.) This is the extreme western range of the Kansas Unionidæ as at present reported.

When young this species is easily identified by its bright green shell and striking rays, but the older shells lose these characters. It may be separated from *Anodonta grandis* by its more pointed beaks, cylindrical shell, and gradually pointed posterior margin. This last is not always constant.

GENUS **SYMPHYNOTA** LEA, 1829.

"Shell elliptic rhomboid, compressed; beaks low, sculpture consisting of strong bars; one pseudocardinal in the right valve and two in the left, the hinder somewhat ∧-shaped, cutting off the hinge plate in the right valve; laterals generally imperfect.

"Animal with the gills semicircular below, inner the larger, filling nearly the whole length from the abdominal sac; marsupium thick, pad-like, filling the outer gills; mantle strongly attached at pallial line; branchial opening papillose; anal opening without papillæ." (Simpson.)

Symphynota costata RAFINESQUE. Plate LXXVI, fig. 1.

Alasmidonta costata Rafinesque, Ann. Gen. Sci. Brux., V, 1820, p. 318, pl. LXXXII, figs.15, 16.

Alasmodonta rugosa Barnes, Amer. Jour. Sci. and Arts, VI, 1823, p. 278, pl. XIII, fig. 21.

Shell large, elongate oval, moderately thick, compressed in male, less so in female. Anterior margin an abrupt curve; anterior portion of ventral margin gently curved, posterior portion straight; posterior margin roundly biangulate; dorsal margin straight or slightly curved. Umboidal ratio, from 0.25 to 0.30. Umbones flat and low, marked with three very coarse, parallel ridges. Umboidal slopes all flatly rounded, the posterior slope marked with a series of moderate-sized undulations which are curved slightly upward anteriorly. Lines of growth coarse, numerous, continuous. Epidermis horn color to deep brown. Ligament long, dark brown.

Interior: Pseudocardinals large, erect, serrate, double in the left and single in the right valve. Lateral teeth indicated only by an indistinct broken ridge on each hinge plate. Anterior scars rather large, smooth; adductor cicatrix deeply impressed in its dorsal portion; retractor cicatrix lightly impressed and generally fused at the anterior end with the adductor cicatrix. Posterior scars large, lightly impressed, fused. Dorsal cicatrices a row of small scars almost at the base of the pseudocardinals. Pallial impression sometimes well marked. Cavity of the umbones slight, of the shell moderate. Nacre rich cream color in the cavity of the shell, white marginally, iridescent posteriorly.

Length.	Height.	Width.	Um. ra.		
126	65	37	0.27	♂	(15.2)
106	62	48	.28	♀	(15.1)
130	68	44	.30	♂	(Coll. W. C.)
115	68	43	.29	♀	(Coll. W. C.)

S. rugosa is distributed throughout the Mississippi valley, and is also found in Manitoba, in the St. Lawrence drainage, and at Columbus, Miss. In Kansas it has been found only in the Neosho river and two of its tributaries, the Cottonwood river and Fall river. I do not believe this to be a common species at any place in the state.

There will be no difficulty in identifying this form. The peculiar lateral teeth rudiments will at once indicate the genus and the rugose posterior slope the species. The two sexes are easily distinguished; the female is much shorter and more inflated than the male. Aside from the sexual variation, the only other decided variant is the number and character of the posterior undulations.

Symphynota complanata BARNES. Plate LXXVI, fig. 2.

Alasmodonta complanata Barnes, Amer. Jour. of Sci. and Arts, VI, 1823, p. 278, pl. XIII, fig. 21.

Shell large, moderately thick anteriorly, thinner posteriorly, wide ellipsoid, compressed in male, less so in female; young specimens strongly alate, but this character often lost in older specimens. Anterior margin rounded; ventral margin well rounded in female, less so in the male; posterior margin roundly biangulate in young, rounded in old specimens. Wing high in old, pointed in young specimens. Umboidal ratio, 0.20 to 0.25. Umbones flattened and marked with four or five rows of double-looped, coarse, V-shaped ridges. Umboidal slopes flattened in male, flatly rounded in female. Epidermis in young specimens smooth, shiny, light to dark brown, sometimes rayed, in old specimens rough, dark brown to black, eradiate. Lines of growth raised, continuous, numerous, sometimes slightly wavy at the base of the wing. Ligament long, light brown.

Interior: Pseudocardinals variable, generally double in left and single in the right valve, large, pyramidally serrate. Lateral teeth indicated by a low, irregular ridge on each hinge plate. Interdentum sometimes present, sometimes excavated in the right valve to form a socket for the anterior left pseudocardinal. Anterior muscle scars not deeply excavated but large. Posterior scars large, fused, lightly outlined. Pallial line slightly impressed anteriorly, outlined posteriorly. Dorsal muscle scars pitted, numerous on posterior face of pseudocardinals. Cavity of the beaks slight, of the shell moderate, greatest in females. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um ra.	P. v.-p. d. angle.		
188	110	52	0.21+	140°	♂	(16.1)
171	105	62	.21	131°	♀	(16.2)
134	78	34	.23	155°	♂	(16.3)
160	96	56	.22+	138°	♀	(*)
162	92	51.5	.23	142°	♂	(*)

S. complanata is found in the Mississippi drainage north of the Arkansas river and in the St. Lawrence drainage. It is a common species in all the drainage basins of Kansas, and has been reported as far west as Wichita and the Solomon river at Minneapolis. It ranks close to *Lampsilis luteola* in abundance in the streams of the northeastern part of the state. Although most abundant in water from six to twelve feet in depth and in a mud bottom, smaller specimens may often be found in company with such forms as *Quadrula plicata* and *Tritogonia tuberculata* in swift-flowing water of a foot or less in depth and embedded in a gravelly bed. It attains a size equal to any *Unio* in the state. It possesses a strong musculature, is a rapid burrower, and is very tenacious of life.

GENUS **UNIO** RETZIUS, 1788.

"Shell inequilateral, oval to elongated, rounded in front and pointed or biangulate behind, with a more or less developed posterior ridge, often becoming slightly arcuate when old; beaks only moderately full, generally sculptured with coarse ridges, which run parallel with the growth lines, or are somewhat doubly looped, sometimes broken and showing fine radiating lines behind; surface smooth, slightly concentrically ridged or pustulose; epidermis rather dull colored, rayless or feebly rayed; hinge plate narrow, two pseudocardinals and two laterals in the left valve, and one pseudocardinal and one lateral in the right, with rarely a vestige of a second lateral; cavity of the beaks not deep or compressed.

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* From Minneapolis, Kan., high-school collection.

"Animal having the inner branchiæ free from the abdominal sac for from one-half to their entire length; marsupium occupying the whole length of the outer gills only, forming a thick, smooth bag when filled with young; gills united to the mantle behind to their extreme points or very nearly so; papillæ on branchial and anal openings unbranched; superanal opening always closed below." (Simpson.)

Unio gibbosus Barnes. Pl. LXXVII.

Unio gibbosus Barnes, Amer. Jour. Sci. and Arts, XIV, 1828, p. 286.
Unio arctior Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 10, pl. IV, fig. 10.

Shell rather large, thick, but variable in this respect, thickest anteriorly, elongate, flat ellipsoid, often tapering posteriorly, compressed. Anterior margin shortly rounded; ventral margin straight, often slightly sulcate posteriorly; posterior margin more or less roundly pointed; dorsal margin long and curved, sometimes curving insensibly into the posterior margin, oblique, and set on an average angle of about twenty-five degrees from the ventral margin. Umboidal ratio quite constant, approximately one-fourth of the entire length. Umbones flat, and marked with several coarse concentric ridges. Anterior umboidal slope rounded; lateral slope flatly rounded and sometimes marked with a broad, shallow radial furrow posteriorly; posterior umboidal slope abruptly curved; umboidal ridge quite well marked. Lines of growth numerous, continuous, in older specimens imbricated, particularly posteriorly. Ligament long, stout, rich brown in color. Lunule long and slender.

Interior: Pseudocardinals low, rounded, thick, evenly serrate, double in the left and single in the right, but often with one or two auxiliary spurs in the right valve. Laterals long, more or less oblique, straight, slightly curved, slightly roughened posteriorly. Interdentum broad and long. Anterior adductor cicatrix of moderate depth and size, sometimes placed slightly under the anterior pseudocardinals, particularly in old specimens. Retractor cicatrix well impressed, variable in shape and size. Posterior scars moderate in size, long, somewhat fused, impressed, often deeply. Pallial line impressed anteriorly and often its entire length. Dorsal cicatrices a row of pits on the under side of the interdentum. Hardly any umboidal cavity; cavity of shell moderate, branchial outline distinct. Nacre from milk-white to pink or deep purple, sometimes almost leaden, often white anteriorly and purple posteriorly; iridescence hardly present.

Length.	Height.	Width.	Um. ra.	
107	47	31.5	0.21	(53.1)
114	52	34	.19+	(250.1)
108	50	35	.21	(300.1)
115	48	34	.21	(53.2)
99	50	35.5	.19+	(300.1)

U. gibbosus is distributed throughout the Mississippi drainage, the St. Lawrence drainage, and the Alabama drainage. It is also found from northern Florida west to the Guadalupe river, Texas. Its distribution in Kansas is rather peculiar. In the clear waters of the southern drainage it is a common species; in the Marais des Cygnes and its tributaries it is very abundant, perhaps the most so of any *Unio*. In the Kansas drainage, however, I know of only one specimen being found. This was a single valve, picked up at Blanton ford, on the Wakarusa river, near Lawrence. This is the only specimen from this stream, although the river has been thoroughly collected. It is found both on gravel bars and riffles, and in deep water, embedded in the mud.

Certain characters of the shell of this species are extremely variable. Perhaps the color of the nacre is the most striking of these. It is possible to make up a complete series of specimens of this species, showing a gradual variation of nacre from a deep leaden purple to pure white. Of the white forms the most common is that with a tinge of purple dorsal-anteriorly. Occasionally specimens are found in which the cavity of the shell is pink. In my experience the purple nacre form is the most common in the Neosho river, while the white nacre form is the most abundant one in the Marais des Cygnes. The thickness of the shell is quite variable. There is also much variation in the length and curvature of the dorsal margin; in some specimens the extreme curvature and length of this margin give the shell a peculiar humped appearance. The relation of the height of the shell to its length is commonly about as one to three, but specimens often occur in which the height is one-half or more of the length. It is a peculiar fact that in spite of the variation in the thickness and height of the shell the cubic capacity of the valves bears a quite constant relation to their length. The umboidal ratio is also fairly constant.

U. gibbosus is an easily recognized species in spite of its variation. The only forms with which it might be confused are *Lampsilis recta* and *Ptychobranchus phaseolus*. The distinguishing characteristics are mentioned in the notes on those two species.

Unio tetralasmus SAY. Plate LXXVIII, fig. 1.

Unio tetralasmus Say, Amer. Conch., III, 1830, pl. XXIII.
Unio symmetricus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 164.
Unio jamesianus Lea, Proc. Acad. Nat. Sci. Phila., I, 1857, p. 84.

Shell moderate to large, moderate thickness, long elliptical, slightly compressed. Anterior margin rounded; ventral margin slightly bowed and forming quite a sharp angle with posterior margin; posterior margin straight or slightly bowed; dorsal margin straight and forming an approximate angle of 140 to 145 degrees with the posterior margin. Umboidal ratio, 0.20 to 0.30. Umbones full, decurved, and marked with from five to eight rather coarse concentric ridges. Anterior umboidal slope fully rounded; lateral slope moderately rounded; posterior slope slightly angular. Epidermis smooth and shining, except for an occasional narrow rough band and for the dorsum of the posterior slope; in color from light horn to dark seal-brown, sometimes marked obscurely with fine rays of dull olive-brown. The color of the epidermis is often arranged in broad concentric but not continuous bands of light and dark; umbones generally brown. Lines of growth fine, slightly imbricated, and continuous. Ligament long, narrow, and black.

Interior: Pseudocardinals thin, erect, plate-like, high or low, double in left and single in the right valve, as a whole very variable. Laterals thin, of moderate length, and slightly curved. Anterior muscle cicatrices large and only fairly well impressed; posterior scars large, outlined, but not impressed, confluent. Dorsal cicatrices large, shallow pits in the cavity of the umbones. Pallial line marked its entire length, but not compressed. Cavity of the beaks slight, of the shell moderately large. Branchial outlines sometimes slightly marked. Nacre a silvery white.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
70	34	21	0.26	144°	(180.1)
57	29.5	17.5	.20	145°	(180.2)
90	50	30	.24	140°	(*)
67	34	21.5	.26+	140°	(*)
75	36	24	.25	138° (approx.)	(*)

Unio tetralasmus var. **camptodon** Say. Not figured.

Unio camptodon Say, Amer. Conch., v, 1832, pl. xiii.

Unio geometricus Lea, Trans. Amer. Phil. Soc., v, 1832, p. 38, pl. iv, fig. 10.

To be distinguished from the foregoing by a slightly more rhomboid outline and in dull, drab-colored and cloth-like epidermis, which is roughened by frequent coarse, continuous lines of growth. Otherwise agreeing with the species proper.

The general distribution of *U. tetralasmus* is throughout the Mississippi valley as far north as forty degrees latitude and southwest to Mexico. It is also found in the Ohio and Alabama river systems.

In Kansas this species is found in all the drainage areas, but perhaps most frequently in the small, muddy tributaries and the large ponds and lakes of the southern drainage basin. There is hardly another species which has an equal range over the state; it has been reported from as far west as Garden City (Call) in the southern drainage, and as a tributary of the Solomon river at Minneapolis in the Kansas area. I have seen some specimens of remarkable size and beauty from the latter place. It is often found in the Wakarusa river at Lawrence.

In all the material which I have gone over and have personally collected, I have found only one lot which could be referred to the variety *camptodon*. This material was from a pond near Thayer, Neosho county. As Doctor Call did not dis-

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[*] Collection Minneapolis high school.

criminate between the variety and species in his list, it is impossible to make out the respective localities of his material.

There is hardly a *Unio* more subject to variation than this one, particularly in the character of the epidermis and the posterior outline. However, the relation of the height to the length (approximately 1 to 2) and the dorsal posterior angle remain remarkably constant. The species can best be identified by the peculiarly undulated beaks and the broken concentric bands of color of the epidermis.

GENUS **PLEUROBEMA** (RAFINESQUE, 1820) AGASSIZ.

"Shell solid, triangular to rhomboid, usually with a prominent umboidal region; beaks at or near the anterior end of the shell, incurved and pointed over a small but well-developed lunule; beak sculpture coarse, consisting of a few irregular, often-broken ridges with a curve upward posteriorly; posterior ridge present, but low and rounded; epidermis showing rest periods plainly, tawny to olive, often ornamented with rays which show a tendency to break into square spots; hinge rather strong, the plate generally narrow; pseudocardinals double in both valves, in the right valve the inner being smaller; muscle scars deep, the posterior rounded, cavity of the beaks shallow; nacre silvery; male and female shells essentially alike.

"Animal having the inner gills much the larger, rounded below, free from the abdominal sac for a part or all of their length; marsupium occupying the entire outer gills, the ovisacs in some cases seeming to be arranged in pairs. Animal generally yellowish to salmon-red, sometimes more or less brown or blackish." (Simpson.)

Pleurobema æsopus GREEN. Plate LXXVIII, fig. 2.

Unio æsopus Green, Cont. Mac. Lyceum, I, No. 2, 1827, p. 46, fig. 3.
Unio cyphia Conrad, New Fresh-water Shells, 1834, p. 68.

Shell large, thick, particularly anteriorly, roundly trapezoidal, tapering behind, rather inflated dorso-anteriorly. Anterior margin fully rounded; ventral margin gently and equally curved, slightly emarginate posteriorly; posterior margin roundly biangulate; dorsal margin straight and somewhat oblique. Umboidal ratio in specimens examined averaged 0.12 to 0.18. Umbones ornamented with several coarse concentric ridges and a few fine radiating lines. Anterior slope full and rounded; lateral slope rounded anteriorly, occupied by a broad, distinct radial furrow, which extends from the tip of the umbone to the ventral margin; on each side of the dorsal half of the radial furrow is found a scattered row of large, low tubercles which are often quite obscure; posterior umboidal ridge prominent. Posterior slope narrow, abrupt, decidedly incurved dorsally, with broken transverse ridges on the upper half. Epidermis dark horn, brown, black. Lines of growth pronounced and continuous, imbricated marginally. Ligament long, of moderate thickness, dark brown. Lunule well developed.

Interior: Pseudocardinals large, erect, ragged, double in the left and single in the right valve, the right pseudocardinal arising from a pit. Interdentum narrow, not very long. Laterals long, straight, slightly oblique. Anterior adductor cicatrices deeply excavated, rough, roundly triangular in outline; anterior retractor scar deeply pitted; posterior scars large, lightly impressed, fused; dorsal scars large on the lower surface of the interdentum and the base of the pseudocardinals. Pallial line impressed anteriorly, outlined posteriorly. Cavity of beaks and shell moderate. Nacre pearly white.

Length.	Breadth.	Height.	Um. ra.	
125	54	82	0.18	(460.1)
78	43	58	.12+	(Coll. W. C.)
90	42	55	.15+	(471.1)

This species is found in the Cumberland, Ohio and Tennessee river systems, and ranges west to Kansas. I have seen only three specimens from Kansas. These came from the Verdigris river at Coffeyville. They are of the typical form.

Pleurobema cicatricosum SAY. Not figured.

Unio varicosus Lea, Trans. Amer. Phil. Soc., IV, 1829, p. 90, pl. XL, fig. 20.

Unio cicatricosus Say, New Harm. Diss., II, No. 19, 1829, p. 292.

Shell large, thick, extremely ponderous in the region of the umbones and anteriorly, elongately and roundly triangular in outline, subinflated. Anterior margin straight or slightly incurved dorsally, bluntly rounded below; ventral margin straight or slightly emarginate; posterior margin produced below and roundly pointed; dorsal margin oblique and forming a continuous curve with the posterior margin. Umboidal ratio, *nil.* Umbones very full and high, and directed anteriorly, ornamented with a few coarse ridges. Anterior umboidal slope slightly incurved or straight, very abrupt, lateral margin fully rounded anteriorly and flatly rounded posteriorly, ornamented with a number of coarse, concentric folds, which are variable in their elevation; posterior umboidal slope abrupt, slightly rounded. Epidermis marked with numerous coarse, continuous lines of growth, rusty brown to black in color. Lunule large, ligament thick.

Interior: Pseudocardinals high, rough, heavy, double in the left and single in the right valve; the left pseudocardinals sharp, ∧-shaped ridges, of which the posterior is the longer, meeting at right angles dorsally; right pseudocardinal a high truncate pyramid arising from a pit. Interdentum broad and short, cut away in the right valve. Laterals heavy, long, oblique, slightly curved. Anterior adductor cicatrix rather small, very deep, elongate, semicircular in outline; posterior muscle scars rather small, deeply impressed, distinct; dorsal muscle scars extending from the anterior adductor cicatrices to the anterior end of the lateral teeth. Pallial line impressed its entire length. Cavity of the shell not large, of the beaks slight; branchial impression well marked. Nacre satin-white.

Length.	Height.	Breadth.	Um. ra.	
75	53*	47	*nil.*	(477.1)

The range of this species as given by Simpson is the Ohio river, Tennessee, and possibly Claiborne, Ala. This is the first report of its occurrence west of the Mississippi. The one specimen which was found came from a gravel-bed on the Neosho river near the southern state line.

There is considerable variation in the extent of the folds on the lateral slopes.

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*Taken through region of pseudocardinals.

TETRAGENEÆ.

"Male and female shells alike, solid; beak sculpture consisting of coarse subparallel ridges; beak cavities deep; marsupium filling all four gills, smooth, pad-like." (Simpson.)

GENUS **QUADRULA** (RAFINESQUE, 1820) AGASSIZ.

"Shell triangular quadrate or rhomboid, solid, inflated, with rather prominent beaks, which are generally sculptured with a few coarse, irregular, subparallel ridges that are inflated when they cross the posterior ridge; posterior ridge ordinarily well developed; base often incurved in old specimens; disks sculptured or smooth; epidermis usually dull colored, dark, and rayless or feebly rayed; hinge plate heavy, wide, flattened; pseudocardinals solid, direct, ragged; laterals double in the left and single in the right valve, often with a secondary lateral below the large one in the right valve; cavity of the beaks deep and compressed; dorsal scars under the hinge plate; male and female shells alike.

"Animal having the inner gills the larger, generally free from the abdominal sac the greater part or all of their length; marsupium occupying all the four gills throughout, the whole smooth and pad-like." (Simpson.)

Quadrula plicata SAY. Plate LXXIX.

Unio plicata Say, Nich. Encyc., II, 1816, pl. III, fig. 1.

Shell large, thick, particularly anteriorly, wide, oval in outline. Anterior margin flatly curved; ventral margin gently bowed; posterior margin bluntly rounded or roundly biangulate; dorsal margin straight or slightly curved and slightly oblique. Umbones large, inflated, high, directed anteriorly, sculptured at the tips with several coarse ridges. Umboidal ratio, from 0.07 to 0.14. The disk of the shell covered with from four to nine coarse, parallel, more or less irregular folds, which extend obliquely from the highest portion of the beaks to the ventral and posterior margins. Anterior slope short, abrubtly curved; posterior slope somewhat abrupt, slightly excavated, sometimes marked with a series of short plications which are directed upwards at the dorsal margin. Epidermis dark brown to black in color, rough except over the umbones. Lines of growth coarse and continuous, imbricated marginally. Ligament long and stout, black. Lunule large.

Interior: Pseudocardinals large, high, heavy, ragged, double in the left, and single and sometimes double in the right valve; when double the right anterior tooth is small and low. Laterals of moderate length, stout, curved slightly downward. Interdentum broad, flat, cut away in the right valve to receive the posterior left pseudocardinal. Anterior muscle cicatrices large, long, and narrow, of only moderate depth, with roughened floors; adductor cicatrix often curved a little around the anterior pseudocardinal. Posterior scars large, lightly impressed, fused. Pallial line heavily impressed and crenulate anteriorly. Cavity of the beaks not large, of the shell fairly large. Nacre white, very iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
150	99	71	0.09	(14.1)
134	86	47.5	.08	(314.1)
113	78	53	.09	(316.1)
120	87	64	.12	(318.1)
101	55	47.5	.09	(314.3)

Q. plicata ranges from Lake Winnipeg and Lake Erie south to the Arkansas and Tennessee rivers. It is common in all Kansas drainage areas, although it is not as abundant as the closely related *Q. undulata.* It is reported as far west as the Whitewater river in the Arkansas drainage (Call), and as Wild Cat creek, Riley county, in the Kansas drainage (Popenoe). I do not think that the species ranges much further west than this latter point. *Plicata* is found buried in deep mud in from two to ten feet of water, along with such forms as *Symphynota complanata* and *Tritogonia turberculata.* In favorable conditions the shell becomes very massive and attains some size; a specimen from the Blue river was 165 mm. in length and the dry shell weighed 800 grams. Another specimen was 195 mm. in length.

Q. plicata is separated from the other undulate *Unios* by its full, high beaks and curved dorsal margin. The plications are very variable in extent and distinctness.

Quadrula perplicata CONRAD. Not figured.

Unio perplicatus Conrad, Proc. Acad. Nat. Sci. Phila., I, 1841, p. 19.
Unio atrocostatus Lea, Trans. Amer. Phil. Soc., X, 1847, p. 70, pl. II, fig. 5.

Shell large, quite thick, somewhat inflated, quadrate, wider before than behind. Anterior margin flatly rounded; ventral margin regularly and gently bowed; posterior margin flatly rounded, inclined to be biangulate; dorsal margin straight, directed somewhat upward. Umboidal ratio, about 0.25. Umbones fairly inflated, but not very high. Anterior umboidal slope rather abruptly rounded; lateral slope fully rounded; posterior slope wide, flattened, inclined to be slightly excavate. Lateral slope ornamented with a series of more or less regular folds, four to seven in number, directed obliquely across the disk from the umbones to the ventro-posterior margin; the posterior slope bearing a continuation of the series of folds, which in this region are smaller, arranged more transversely, and bowed dorsally at either end. Epidermis glossy chestnut brown, with imbricated lines of growth marginally. Lunule small. Ligament short and stout.

Interior: Pseudocardinals of moderate size and height, roundly pyramidal, double in the left, and single, with sometimes one or two auxilaries, in the right valve. Interdentum broad, smooth, rather long. Laterals short, straight, a little oblique. Anterior adductor cicatrix evenly and shallowly excavated, with a roughened floor, uniform in outline; posterior scars broader than long, lightly impressed, confluent; dorsal muscle scars on the lower surface of the interdentum and pseudocardinals. Pallial line impressed and crenulate the first two-thirds. Cavity of beaks and shell fairly large. Nacre a beautiful silver-white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
87	50	44	0.23	(470.1)

Q. perplicata is a Southern species, found in the Alabama drainage and the streams flowing into the Gulf of Mexico, as far west as central Texas and north to Kansas. The only specimens from Kansas of which I have personal knowledge are two received from Doctor Newlon, from the Neosho river at Oswego. Simpson (20) state sthat this form is found in southern Kansas, but gives no exact localities.

This species is shorter and higher than *Q. plicata;* and the dorsal margin of *Q. perplicata* is straight and directed upward, while that of *Q. plicata* is generally curved and directed ventrally. The rather high beaks of *Q. perplicata* will serve to distinguish it from *Q. undulata.*

Quadrula undulata BARNES. Plate LXXX, fig. 2.

Unio undulatus Barnes, Amer. Jour. Sci., VI, 1823, p. 120, pl. II.

Shell large, solid, thickest anteriorly, elongate quadrate in outline, somewhat compressed. Anterior margin flatly rounded; ventral margin gently bowed; posterior margin roundly biangulate, the dorsal posterior margin being approximately three times the length of the ventral posterior margin; dorsal margin straight, except for the posterior third, which is slightly curved. Umboidal ratio extremely variable, from 0.10 to 0.30. Umbones compressed, flattened, and incurved, marked with from four to six coarse, concentric ridges. Disk of the shell covered with a series of coarse oblique folds, which run from the highest points of the umbones to the posterior and dorsal margins. The plications are from five to eight in number, but break up considerably marginally. Posterior umboidal slope slightly excavated and covered with a parallel series of undulations, which are directed dorsally. The anterior of these undulations arise independently on the umbones; the posterior ones are continuations of the dorsal disk undulations. Epidermis chestnut brown to black in color. Lines of growth coarse, numerous, continuous, imbricated posteriorly. Ligament long, stout, black. Lunule long and slender.

Interior: Pseudocardinals of moderate size, double in both valves, those of the left valve high, pyramidal, ragged; the posterior of the right valve high, rough, and pyramidal, the anterior small and lamellar. Interdentum long and narrow, cut away in the right valve to receive the posterior right pseudocardinal. Laterals long, either thick or thin, slightly curved. Anterior adductor cicatrix kidney-shaped, of moderate and even depth, floor roughly pitted; protractor cicatrix large and rough; posterior scars large, faint, confluent. Pallial line impressed and crenulate for the anterior two-thirds of its length. Dorsal muscle scars variable in shape and number. Cavity of the beaks deep, of the shell moderate; branchial depression well outlined. Nacre white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
130	80	53	0.26	(14.1)
105	67	35	.18+	(312.2)
90	58	39	.26	(14.2)
110	72	37	.13+	(312.1)
114	58	42	.12	(313.1)

Quadrula undulata var. **latecostata** LEA. Not figured.

Unio latecostatus Lea, Proc. Amer. Phil. Soc., IV, 1845, p. 163.

Distinguished from the species proper by the finer and more regular undulations and thinner and more compressed shell.

Quadrula undulata var. **pilsbryi** MARSH. Not figured.

Unio pilsbryi Marsh, Nautilus, V, 1891, p. 1.

Differs from the species in being produced ventro-posteriorly and in bearing plications which tend to break up into short transverse bars.

Q. undulata has very extensive distribution. It is found throughout the Mississippi basin north into Canada and the St. Lawrence drainage, south in the Alabama river system, west almost to Mexico. It is a common species in all the drainage areas of Kansas, but is, perhaps, most abundant in the smaller tributaries of the Kansas river. Here it stands next to *Lampsilis luteola* in abundance, and the riffles are often covered with the shells. The reported range is as far west as the Smoky Hill river at Salina; it probably goes much further west. On Chapman creek, a tributary of the Smoky Hill, it is very abundant; in a lot of about 150 shells, fully fifty per cent. were *Q. undulata*, but there was not a single specimen of the nearly related *Q. plicata* in the lot.

The variety *latecostata* is found only in the southern drainage. The best examples I have seen were from Lake Thayer, in Neosho county. Simpson (20) has stated that it is in Kansas that this form merges with the true species. This I believe to be true, for while transitional forms between the variety and the species are common in the Kansas river drainage, the typical variety is yet to be found there.

The form *pilsbryi* was originally described as a distinct species from Arkansas. Specimens of the variety from Kansas correspond very well with specimens of *pilsbryi* from the former state. As yet it has been reported from only two localities in the state—Ottawa creek, a small tributary of the Marais des Cygnes, and Mill creek, in the Kansas drainage.

This species is not particular as to habitat, and its distribution is entirely uninfluenced by the depth of the water in which it lives; sandy bottoms, however, are avoided. The main distinctions between this and other closely related forms has been already pointed out.

Quadrula heros SAY. Plate LXXX, fig. 1.

Unio heros Say, New Harm. Diss., II, No. 19, 1829, p. 29.
Unio multiplicatus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 70, pl. IV, fig. 2.

Shell large, of moderate thickness, rhomboid in outline, compressed anteriorly, somewhat inflated medianly. Anterior margin flatly rounded; ventral margin gently curved; posterior margin straight except for the slight undulations caused by the folds of the shell; dorsal margin straight. Umboidal ratio, 0.08 to 0.12. Umbones rather flattened and sculptured, with very coarse double-looped ridges, which further down the disk break up into rows of crescent-shaped nodules, which extend from one-half to one-third of the distance down the anterior slope. Anterior and lateral slopes flatly rounded; posterior slope slightly excavated. Disk ornamented with a series of oblique coarse folds, which extend from a line on the disk which would pass through the umbones to the posterior margin. The dorsal ridges curve decidedly upward to the dorsal margin. Epidermis very dark brown to black. Lines of growth numerous and continuous and imbricated posteriorly. Ligament short, thick, dark brown.

Interior: Pseudocardinals large, high, heavy, ragged, double in the left and single and sometimes double in the right valve; when double in the right the anterior tooth is small and weak. Laterals short, stout, curved slightly ventrally. Interdentum broad and flat, but cut away in the right valve to receive the posterior pseudocardinal. Anterior muscle cicatrices both long and narrow, of moderate depth, and with roughened floors; the anterior pseudocardinal often curved about half-way around the base of the pseudocardinals. Posterior scars large, lightly impressed, longer than wide, confluent. Pallial line crenulate and heavily impressed anteriorly. Dorsal scars well impressed, scattered over the ventral surface of the interdentum. Cavity of the shell quite deep, of the beaks large. Nacre pure white, very iridescent along the posterior margin.

Length.	Height.	Breadth.	Um. ra.	
150	99	71	0.09	(14.1)
134	86	47.5	.08	(314.2)
113	78	53	.09	(316.1)
128	87	64	.12	(318.1)
101	55	41.5	.09	(314.3)

Q. heros is found throughout the Mississippi valley, east into Alabama, west into Mexico. It has been reported from all the drainage systems in Kansas. In the Kansas and the southern drainage basins it is a rare species. In the Marais des Cygnes system it is occasionally found, but it is not at all common. Although this is said to be the largest *Unio* of American waters, I have not seen specimens of any great size from the Kansas streams. There will be no difficulty in distinguishing *heros* from the other undulate *Unios*. It is the only form in which the umbones and the greater part of the anterior umboidal slope are covered with pustules.

Quadrula cylindrica Say. Plate LXXXI, fig. 2.

Unio cylindricus Say, Nich. Encyc., II, 1816, pl. IV, fig. 3.

Shell of moderate size, elongate rectangular, thick, inflated, nodulated, height about one-third of the length. Anterior margin almost semicircular; ventral margin straight except where it is inbowed by a long, very shallow indentation; posterior margin bluntly pointed, the ventro-posterior margin short and straight, dorsal posterior margin longer and incurved; dorsal margin straight and meeting the dorsal posterior margin at a fairly constant angle. Umboidal ratio, approximately 0.20. Umbones prominent but not high, marked with coarse lines and small nodules. Anterior umboidal slope fully rounded; lateral slope well rounded, and together with the anterior is marked with obscure, low, small, triangular-shaped elevations; in some cases the dorsal margin of the anterior slope is marked with a few small undulations. Posterior ridge well marked, rounded, with a series of from three to five large irregular nodules which vary greatly in their prominence. Posterior slope flat and more or less undulated. Lines of growth rounded and continuous. Epidermis horn color or russet, marked with numerous triangular patches of dark green, which extend only a short distance up from the ventral margin. Ligament fairly strong, long, dark chestnut.

Interior: Pseudocardinals rather small, low and pyramidal, double and sometimes trifid in each valve. Anterior cicatrices small, quite deep, sometimes fused; posterior scars of moderate size, very faintly outlined, confluent. Dorsal cicatrices small and located on the lower surface of the interdentum. Pallial line impressed in the anterior half. Nacre pure white, iridescent posteriorly.

Length.	Height.	Breadth.*	Um. ra.	Posterior ventral angle.	
97.5	40.5	30	0.20+	137°	(185.1)
100	39.5	30	.21	134°	(186.1)
96.5	41	30.5	.21+	130°	(186.2)
87	37	26.5	.20	131°	(186.3)

Q. cylindrica ranges from the Ohio, the Cumberland and the Tennessee river systems west to Kansas. It is found in Kansas only in the clear-water streams of the southern drainage—the Spring, the Neosho, and the Verdigris. Although seeming to be nowhere abundant, it is not a rare species in the streams mentioned. Its favorite habitat is bars of gravel or shingle in a rather swift current. The thick and nodulous shell fits it admirably for these conditions.

This is one of the most distinct and easiest recognized *Unios* found in Kansas waters. At first sight the elongate shell makes it appear out of place among the other members of its genus, but all the members of the small group to which it belongs have marked peculiarities of shell. The nodules vary much in different specimens, and I have seen specimens in which they were low and evenly rounded, but generally this is the most striking character of the shell. The epidermal markings and the pseudocardinals exhibit minor variations.

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* This measurement is taken through the umbones.

Quadrula metanevra RAFINESQUE. Plate LXXXI, fig. 1.

Obliquaria (*Quadrula*) *metanevra* Rafinesque, Ann. Gen. Sci. Brux., v, 1820, p. 305; pl. LXXXV, figs. 15, 16.

Shell generally of moderate size, thick, thickest anteriorly, somewhat compressed, trapezoidal in outline. Anterior margin and the anterior half of the ventral margin almost forming a semicircle, remainder of the ventral margin at first slightly incurved and then forming a rounded and produced lobe, of which the ventral portion of the posterior margin forms the upper part. Upper portion of posterior margin almost straight; dorsal margin straight or slightly curved. Umboidal ratio, approximately one-third. Umbones large and full; when not worn (as is usually the case), triangular and sharp. Anterior and lateral umboidal slopes fully rounded, and more or less ornamented with large, low, tubercles, sometimes entirely smooth; umboidal ridge very prominent, rounded abruptly anteriorly and posteriorly, widening ventrally, generally bearing several large irregular nodules and also low tubercles; posterior slope rounded and ornamented dorsally with obscure broken ridges. Lines of growth prominent, regular, and continuous. Epidermis variable in color, from straw to deep chestnut-brown, often marked with dark green triangular patches, the apices of which are directed vertically. Ligament short, thick, honey-brown to black in color.

Interior: Pseudocardinals large, low, massive, coarsely striate, double in the left valve, with one large and one or two low auxiliary teeth in the right valve. Laterals short, very heavy, generally curved, but sometimes straight oblique, sometimes inclined to be double in the right as well as the left valve. Interdentum broad and flat. Anterior adductor cicatrix well marked but shallow, placed in front of the pseudocardinals; posterior scars large, lightly impressed, often fused, and sometimes roughened. Pallial line impressed anteriorly, sometimes throughout its length. Dorsal scars on the base of the interdentum. Cavity of the shell moderate, of the beaks deep. Nacre pure white.

Length.	Height.	Breadth.		
55	48.5	36	(242.1)	
77	63	49		(Coll. K. S. A. C.)
74	54	35	(241.2)	
77	60	41.1	(240.1)	

Q. metanevra occurs throughout the northern portion of the Mississippi valley. In Kansas it is confined to the clear-water rivers of the southern drainage, being found as far up the Neosho as its juncture with the Cottonwood river. Gravel-bars are its favorite habitat. Although well distributed it is never (in the author's experience) very common. The largest specimen I have ever seen from this state came from Fall river, a tributary of the Neosho. It is in the Popenoe collection of the State Agricultural College and its dimensions are given above.

It will be impossible to confuse this *Unio* with any other found in Kansas. The umboidal ridge, semicircular in outline, will alone serve to distinguish it. There is much variation in the character of the nodules found on the umboidal ridge. The Kansas representatives are all less nodulous in this region than are those of a series which I have examined from the Cumberland river of Tennessee.

Quadrula aspera Lea. Not figured.

Unio asper Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 85, pl. XIX, fig. 15.

‘‘Shell subtriangular, angular behind and rounded before, covered with small, rough tubercles, except in a furrow which passes from the beak obliquely to the basal margin, which is there arcuate; the tubercles on the posterior slope arrange themselves into a series of undulations as far as the beaks; substance of the shell thick; beaks slightly prominent, ligament short and thick; epidermis brown and wrinkled; cardinal tooth rather large, slightly elevated, and widely cleft in the left valve, single emerging from a pit in the right; lateral teeth small, slightly curved in a direction over the cardinal teeth; posterior and anterior cicatrices both distinct; dorsal cicatrices situated on the under part of the cardinal tooth, within the cavity; cavity of the beaks deep and angulated; nacre very pearly and iridescent." (Lea.)

This species, according to Simpson, ranges from Kansas south to Texas. I have never found this species in the state, nor is it present in any of the collections of Kansas *Unios* which I have examined. It is very close to *Q. lachrymosa.* I admit it only on Simpson's authority. Doctor Dall states that it has been collected from the Neosho in Indian Territory. The description is Lea's original in the Transactions of the American Philosophical Society.

Quadrula lachrymosa LEA. Plate LXXXII, fig. 2.

Unio lachrymosus Lea. Trans. Amer. Phil. Soc., III, 1828, p. 272, pl. VI, fig. 8.

Unio asperrimus Lea. Trans. Amer. Phil. Soc., IV, 1831, p. 71, pl. V, fig. 3.

Shell moderate to large, solid, thickest anteriorly, compressed or moderately inflated, quadrate in outline. Anterior margin and the anterior third of the ventral margin one regular and almost circular curve, remainder of the ventral margin straight or slightly incurved; posterior margin slightly curved, straight, or emarginate; dorsal margin straight or a little curved, slightly oblique, connecting with the posterior slope at an angle of from 90 to 120 degrees. Umboidal ratio, 0.25 to 0.40. Umbones small, moderately elevated, incurved, ornamented with small, double-looped nodulous ridges. Anterior umboidal slope rather fully rounded; lateral slope more or less grooved with a broad, shallow, radial furrow, the sides of which are commonly ornamented with an irregular band of tubercles, which is made up of many small and a few large, tear-like projections. These bands rarely extend to the ventral margin, and the posterior is generally the shorter of the two. Postumboidal ridge generally well marked and posterior slope generally slightly excavated and more or less pustulose dorsally. Epidermis fairly smooth and sometimes shiny, in color from greenish horn to dark chestnut-brown. The umbones of the young shells are often covered with a large triangular patch of dark green. Lines of growth numerous, raised, and continuous. Ligament thick, dark brown. Lunule long and narrow.

Interior: Pseudocardinals high, pyramidal, ragged, single in the right and double in the left valve, the right pseudocardinal being surrounded by a shallow, rounded ditch. Laterals straight or curved, long, high, oblique. Interdentum variable, cut away for the right valve to receive the left posterior pseudocardinal. Anterior adductor cicatrix semicircular in outline, fairly deep. Posterior cicatrices slightly larger than the anterior ones, well marked, confluent. Pallial line well impressed for its anterior two-thirds. Dorsal scars a row of pits on the lower surface of the interdentum and pseudocardinals. Cavity of the beaks large and deep, of the shells moderate. Nacre pearly white, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
106	96	67	0.36	112°	(18.1)
105	65	47	.24	110°	(320.1)
82	69	48	.31	93°	(322.1)
90	65	41	.30	115°	(321.1)
79	63	40	.33	122°	(19.1)

Q. lachrymosa is found in the St. Lawrence basin and the Mississippi drainage. It ranges southwest into Texas. It is a common species in all the Kansas systems and particularly abundant in the eastern Kansas drainage. It has been reported as far west as the Smoky Hill river at Salina. This species is not at all choice as to habitat. It often rivals *Obovaria ellipsis* as a habitant of sand-bars, and is also found in mud or shingle in water of variable depth.

The shell is as variable as its environment. The epidermis may be greenish yellow or dark brown, the tubercles numerous and erect or few and obscure. The size of the adult shell is also a variant. The shells of the animals living in muddy stations are large and massive; those from sand-bars thinner and smaller. The author found in a large series of material taken from beds of shingle in the Wakarusa river that the mean relation of the length to the height was 1.110 : 1.000. The extremes were 1.029 : 1.000 and 1.218 : 1.000, respectively.

The chief distinctions between this and other members of the *lachrymosa* group will be found under *Q. aspera* and *Q. fragosa*.

Quadrula fragosa CONRAD. Plate LXXXII, fig. 1.

Unio fragosus Conrad, Mon. Fresh-water Shells, II, 1836, p. 12, pl. VI, fig. 2.

Shell of moderate size, fairly thick, thickest anteriorly, quadrate in outline. Anterior margin and the first half of the ventral margin a full curve ; posterior half of the ventral margin slightly incurved ; posterior margin almost straight and at right angles to the posterior half of the ventral margin ; dorsal margin straight or slightly curved, slightly oblique. Umboidal ratio variable, from 0.20 to 0.30. Umbones of moderate height and inflation, incurved, tuberculate. Anterior umboidal slope smoothly rounded ; lateral slope marked posteriorly by a wide radial furrow, along each side of which is a row of erect, prominent tubercles, which run from the umbones to the margin ; minor tubercles are scattered among the major ones, particularly those of the anterior series ; posterior umboidal slope somewhat excavated and covered with a series of small, irregular plications, which are gently bowed ventrally. Lines of growth fairly continuous and prominent. Epidermis horn color to seal-brown. Ligament short, of moderate thickness, light brown in color. Lunule small.

Interior : Pseudocardinals large, erect, serrate, double in the left and single in the right valve. Interdentum broad and short, quite oblique. Anterior adductor scar placed in front of the pseudocardinals, set slightly under the anterior left pseudocardinal, small, quite deeply excavated, with a level floor. Posterior scars of moderate size, impressed, distinct. Pallial line impressed for the greater part of its length Dorsal muscle scars few but well marked, placed on the lower surface of the pseudocardinals. Cavity of the shell moderately large, of the beaks large. Nacre silvery white, iridescent on the posterior half.

Length.	Height.	Breadth.	Um. ra.	
76	62	41	0.20	(245.1)
62	50	29.5	.30	(244.1)
62	53	38	.28	(280.1)

This species is found in the Ohio, Cumberland and Tennessee river drainage systems and ranges west into Kansas, Nebraska, and Minnesota. In Kansas it is confined to the southern drainage system. It has also been reported from

Soldier creek, a tributary of the Kansas river from the north, but I think that it is quite possible that this is a mistake. In my collecting this shell has always been a rare one.

Although closely related to *Q. lachrymosa*, the species at hand is quite a distinct one. The anterior umboidal slope is less extensive than in *Q. lachrymosa*, and the tubercles are more numerous and erect. The posterior umboidal slope is covered with tubercular transverse plications. The same region of *Q. lachrymosa* bears scattered tubercles only.

Quadula speciosa Lea. Not figured.

Shell entirely covered with tubercles, almost quadrate, much compressed, the sides flattened, almost equilateral. Posterior margin slightly biangular and emarginate ; anterior margin rounded ; hinge fairly heavy, beaks subelevated, sharp, with fine undulations ; epidermis greenish yellow, somewhat furrowed, sometimes obscurely rayed, sometimes eradiate, a little shiny ; cardinal teeth fairly large, compressed oblique, erect, striate, double in either valve ; lateral teeth straight, fairly long, oblique. Nacre pearly and iridescent.

This form ranges from Kansas south to Texas. I have never found it in the state, but Mr. W. H. Dall informs me that it has been collected from the Smoky Hill river. It is one of the lachrymose *Unios*. Its nearest ally in Kansas waters is *Q. fragosa*. The description is a translation of Lea's original one.

Quadrula pustulosa Lea. Plate LXXXIII, fig. 1.

Unio pustulosus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 76, pl. VII, fig. 7.
Unio dorfeuillianus Lea, Trans. Amer. Phil. Soc., VI, 1838, p. 73, pl. XVII, fig. 54.
Unio schoolcraftensis Lea. Trans. Amer. Phil. Soc., V, 1834, p. 37, pl. III, fig. 69.

Shell of medium size, solid, often quite heavy, orbicular or roundly quadrate, compressed or subinflated. Anterior margin circularly rounded ; ventral margin slightly to decidedly bowed, sometimes slightly produced posteriorly, and at an angle of from 90 to 120 degrees ; posterior angle straight or gently bowed and meeting the dorsal margin at an extremely variable angle ; dorsal margin either straight or bowed, slightly oblique. Umboidal ratio not a constant, varying from 0.15 to 0.35. Umbones vary in height, with moderate inflation, to low and uninflated; ornamented with from three to five broken ridges, but free from pustules. Anterior umboidal slope fully rounded; lateral slope fully or flatly rounded and sometimes bearing a shallow and faint radial furrow; posterior slope generally incurved and often abrupt. The posterior and lateral slopes bearing pustules which may be numerous and cover most of the disk, or may be few and obscure; they are irregular in position and the pustules on the opposite valves do not always correspond; pustules lachrymosal in character but variable in size and outline. Epidermis light horn to dark chestnut-brown in color, the younger and lighter colored specimens ornamented over the umbones and sometimes half-way down the disk with a very broad, triangular green ray, which tends to break up into a number of finer ones; a similar ray is often present on the posterior slope. Lines of growth well marked, darker than surrounding epidermis. Ligament of variable length, stout.

Interior: Pseudocardinals rather heavy, ragged, double in the left and single (with sometimes an anterior and posterior auxiliary) in the right valve; the left pseudocardinals generally but not always joined dorsally; right pseudocardinal large and heavy, surrounded by a pit. Anterior adductor scars deep, semicircular or quadrant-like in outline, extending somewhat under the anterior pseudocardinal in the left valve. Posterior scars rather large for the size of the shell, well impressed, distinct or fused. Pallial line impressed about two-thirds of its length. Dorsal scars in a row on the lower surface of the interdentum and upon the base of the pseudocardinals. Cavity of the umbones quite large, of the shell small.

Interdentum broad and short. Laterals very variable in length, curved or straight, highest posteriorly, set at right angles to the longer axis of the pseudocardinals. Nacre satin or pearly white.

Length.	Height	Breadth.	Um. ra.	Dorsal posterior angle.	
57	50	36	0.22	114°	(41.1)
60	47	18	.20	115°	(463.1)
56	49	33	.25+	130+°	(724.1)
45	45	31	.18	140°	(464.1)
52	43	26	.34	115°	(466.1)

Q. pustulosa ranges over the entire Mississippi drainage and into Michigan, it extends east into the Alabama river system and west to central Texas. It is quite common throughout the Kansas drainage systems. It is found in streams of some size, either in gravel or mud bottom.

Q. pustulosus is one of the most variable species of an extremely variable group. It is hardly possible to write a description of this form which will cover all its varied mutations. The general outline may assume almost any form except a decidedly elongate one, and the umboidal ratio has absolutely no stability. The pustules may crowd the disk or the shell may be practically smooth. The pseudocardinals and laterals are subject to much variation both as to position and to form, and the interdentum may be broad and long or almost absent.

The main distinctions between this and other nearly related forms will be found under the latter.

Quadrula pustulata Lea. Plate LXXXIII, fig. 2.

Unio pustulatus Lea, Trans. Amer. Phil. Soc., 1834, p. 79, pl. VII, fig. 9.
Unio nodulatus Say, Amer. Conch., VI, 1834.

Shell rather small, solid, particularly so anteriorly, suborbicular but for a square dorso-posterior projection, inflated. Anterior margin and anterior half of the ventral margin circularly rounded; posterior half of the ventral margin straight or slightly emarginate; posterior margin straight or very slightly incurved, meeting the dorsal margin at an approximate angle of ninety degrees; dorsal margin straight, oblique. Umboidal ratio, 0.20 to 1.35. Umbones very full, fairly high, decurved, bearing three or four small concentric ridges on their tips. Anterior umboidal slope fully rounded, as is also the lateral one; posterior slope abrupt anteriorly, very flatly curved posteriorly, being produced dorso-posteriorly into a sort of triangular wing, which, however, is in no way analogous to the alæ of the true winged *Unios*. Lateral slope ornamented with two radial rows of small, erect pustules, arranged linearly, and from three to five in number, sometimes with a group of irregularly placed pustules at the marginal end of the rows; posterior slope bearing a few obscure pustules arranged in five or six transverse rows. Epidermis light to dark horn color, with sometimes a light cast of green; young specimens show a green triangular patch over the umbones. Lines of growth far removed, considerably darker than the epidermis of the body of the shell. Lunule small and cordate in outline. Ligament stout and thick.

Interior: Pseudocardinals large for the size of the shell, erect, ragged, double in the left and single in the right valve; the left anterior pseudocardinal generally the larger, the right pseudocardinal arising from a pit. Interdentum broad but very short. Laterals at right angles to the free edge of the interdentum, straight or slightly curved, oblique, fairly long. Anterior adductor cicatrix deeply excavate, semicircular in outline, placed in front of the pseudocardinals; posterior scars small, lightly impressed, confluent. Pallial line impressed its anterior two-thirds. Dorsal cicatrices on the base of the pseudocardinals. Cavity of the shell small, of the beaks rather large. Nacre milk-white, very slightly iridescent posteriorly.

Length.	Breadth.	Height.	Um. ra.	
46	41	33	0.24	(475.1)
47	42	32	.32	(476.1)

Quadrula pustulata occurs in the lower half of the Mississippi drainage, in the Ohio river system, and in southern Michigan. In Kansas it is found only in the Verdigris river and the Neosho, in the southern drainage.

Q. pustulata is generally confused with its near ally, *Q. pustulosa*. It is, however, quite a distinct species. In the form under discussion the dorso-posterior angle is produced in a manner rarely found in *pustulosa*, and the arrangement of the tubercles is entirely different. The tubercles of *Q. pustulosa* are scattered irregularly over the disk; those of *Q. pustulata* are arranged in two radial rows which extend from the umbones to the ventral margin; they are set far apart, at fairly regular intervals. The upper one or two tubercles of the posterior series are sometimes lacking.

Quadrula houstonensis Lea. Not figured.

Unio houstonensis Lea. Proc. Acad. Nat. Sci. Phila., III, 1859, p. 155.

Shell large, thick, moderately inflated, very roundly quadrate, slightly broader below than above. Anterior margin straight or very slightly curved above, abruptly rounded below; ventral margin regularly curved; posterior margin slightly curved and set at about right angles to the ventral margin; dorsal margin straight or slightly curved, oblique. Umbones large, full, high, directed a little anteriorly. Anterior and lateral umboidal slopes full and rounded; posterior slope somewhat truncate and very slightly incurved. Epidermis dark yellow, with smooth, rounded and regular lines of growth, which may be imbricated posteriorly. Ligament high, thick, and of moderate length. Lunule large.

Interior: Pseudocardinals of moderate size and light, double in the left and single (with sometimes a small anterior auxiliary) in the right valve; the left pseudocardinals being low and pyramidal, and arranged as the legs of a broad ∧, the right arising from a deep, ragged pit. Interdentum broad and long. Laterals short, thick, very oblique, curved, highest posteriorly. Anterior adductor cicatrix deep, not large, elongate, roundly triangular in outline. Posterior scars rather small, well impressed, distinct. Dorsal scars in a long row on the under surface of the interdentum and pseudocardinal. Pallial line well impressed its entire length. Cavity of the shell moderate, of the beaks deep and compressed. Nacre silver-white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
73	70	48	0.13	(46.1)

This species is found in Texas, Louisiana, southern Arkansas, and Kansas. It is reported from Mill creek, in the Kansas system (Call), and in the Verdigris (Call) and Spring river. It is not a common species. It resembles smooth specimens of *Q. pustulosa*, but is smooth, heavier and larger than that species.

Quadrula rubiginosa Lea. Plate LXXXIV, fig. 2.

Unio rubiginosus Lea, Trans. Amer. Phil. Soc., iii, 1829, p. 427, pl. viii, fig. 10.

Shell moderate in size, subinflated, solid, elongate and roundly quadrate. Anterior margin fully rounded; ventral margin slightly curved anteriorly, straight or a little emarginate posteriorly; posterior margin straight or slightly curved, more or less produced; dorsal margin straight, slightly oblique, meeting the posterior margin at an approximate angle of 130 degrees. Umboidal ratio, 0.15 to 0.25. Umbones full but not much elevated, ornamented with four to eight rough concentric ridges. Anterior margin fully rounded; posterior position of the lateral slope occupied with a very wide radial furrow; posterior umboidal ridge generally sharp and well defined almost its entire length; posterior slope fairly abrupt and in most cases a little excavated. Epidermis greenish horn to deep chestnut-brown in color, sometimes possessing a cloth-like texture. Lines of growth at irregular intervals and generally of a darker color than the surrounding epidermis. Lunule rather large, elongate. Ligament fairly stout, long or short; color variable.

Interior: Pseudocardinal fairly large, rough, double in the left, single in the right valve. Anterior left pseudocardinal an erect pyramidal ridge, posterior left roundly pyramidal; posterior pseudocardinal heavy and erect, high, surrounded by a trench into which the left pseudocardinals fit. Interdentum very variable in length and breadth. Laterals long, curved or straight oblique. Anterior adductor cicatrix quadrate in outline, deeply excavated; posterior scars deeply impressed, distinct or confluent. Pallial line impressed for one-half its length. Cavity of the beaks rather large, of the shell small. Nacre white or pinkish, iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	Dorsal posterior angle.	
65	46	25	0.21+	137°	(211.1)
78	53	37	.15+	136°	(207.3)
65	45	25	.23	127°	(475.1)
61	44	32	.21	133°	(213.1)

Q. rubiginosa ranges from the St. Lawrence and Nelson rivers, in Canada, to eastern Texas. It is a common species in all the Kansas river systems, but is most plentiful in the Marais des Cygnes. It is an inhabitant of muddy river-beds.

The variation is considerable. The elongation of the posterior slope, the excavation of the radial furrow and the inflation all exhibit it to a marked degree. The young specimens generally bear a series of green rays over the umbones, but this character is not often present in the adult shell.

The two species with which *rubiginosa* might be confused are *Q. trigona* and *Q. coccinea.* Under the descriptions of these two species will be found a statement of the main distinguishing characters.

Quadrula trigona Lea. Not figured.

Unio trigonus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 110, pl. XVI, fig. 40.

"Shell trigonal, thick and heavy, much inflated, broadly rounded, and behind the posterior margin being produced ventrally; dorsal margin curved; ventral margin more or less sinuous; surface more or less shining, roughened by lines of growth; umbones large, elevated, inflated, dark brown, directed anteriorly, and unmarked except by growth lines; anterior umboidal slope short and flatly rounded; posterior slope strongly angled, with an excavation on each side of the angle, which reaches from the apex to the ventral border, where it forms a decided beak-like projection; viewed anteriorly, the shell is strongly heart-shaped, resembling in this respect some cardia, particularly *Isocardia cor.* Ligament short, wide, stout, very dark brown or black; epidermis reddish or blackish horn, unmarked by rays; cardinal teeth double in the left and single in the right valve, very stout, generally not much elevated, triangular, diverging, very deeply grooved and striated; lateral teeth short, solid, elevated, lamellar serrated, directed and curved ventrally; the right lateral and the lower left lateral have each a depression and a rudiment of an additional tooth; connecting bridge thick, wide, flat, smooth; anterior adductor muscle scar forming a truncated oval, very deeply excavated, striated; posterior adductor muscle scar oval, well impressed, striated; *protractor pedis* muscle scar wider than long, deeply impressed, striated; *retractor pedis* muscle scar oval, very deeply pitted, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and the under side of the connecting bridge, deep, large; pallial line impressed; cavity of the beaks deep; nacre silvery white, more or less iridescent." (Baker, 2.)

Q. trigona occurs throughout the Mississippi drainage, north into the St. Lawrence and south into Alabama. It has been reported from all the larger streams of southern Kansas and from Bull creek at Paola (Call), in the Marais des Cygnes drainage.

Trigona is close to *Q. rubiginosa* but is a more inflated and heavier shell, with more massive dentation.

Quadrula coccinea CONRAD. Plate LXXXIV, fig. 1.

Unio coccineus Conrad, Mon. Fresh-water Shells, III, 1836, p. 29, pl. XIII, fig. 1.

Shell of moderate size and solidity, suborbiculate in outline, slightly compressed. Anterior margin flatly or fully rounded, ventral margin gently bowed; posterior margin biangulate, produced below, straight or slightly curved, quite oblique, set at an angle; dorsal margin straight or slightly curved, oblique, joining the posterior margin at an angle of from 130 to 150 degrees Umboidal ratio extremely variable. Umbones quite high and moderately full, marked with numerous fine concentric ridges and three coarse broken ones. Lateral and anterior slopes flatly rounded; posterior slope slightly incurved; posterior umboidal ridge not prominent, rounded. Epidermis smooth, shining, over umbones horn color to dark reddish brown, with the umboidal region covered with bright green rays of variable width. Lines of growth coarse, heavy, and often imbricated. Ligament thick, of moderate length. Lunule cordate.

Interior: Pseudocardinals of medium size and variable height, double in the left and single in the right valve, the right pseudocardinal surrounded by a trench. Interdentum long, width variable, cut away in the right valve. Laterals long, oblique, straight, or slightly curved, heavy, striate, sometimes double in each valve. Anterior adductor scars semicircular in outline and quite deep, rather small when compared to the size of the shell; posterior scars distinct, well impressed, the adductor cicatrix quite elongate. Dorsal muscle scars small pits scattered on the lower surface of the interdentum. Cavity of the shell not large, of the umbones small. Nacre white or salmon-pink.

Length.	Height.	Breadth.	Um. ra.	D. p.-V. p. angle.	
65	50	34	0.10	130°	(53.1)
64	48	35	.21	140°	(401.1)
69	51	31	.17	140°	(Coll. K. S. A. C.)
77	56	40	.29	145°	(402.1)

Q. coccinea is found throughout the Mississippi and St. Lawrence drainage basins. It is common to all the Kansas river systems. I have never found it abundant, although it is generally present in all streams of any size. It is rare in the Wakarusa river at Lawrence and absent from the Kansas river there.

The variation is mainly in the color of the epidermis and the thickness of the shell. The shells from the clear-water rivers of the southern drainage are heavier than those from the Kansas and Marais des Cygnes. The nacre of *coccinea* is either pink or white. The white form is the commoner one.

This species is often confused with *Q. rubiginosa*. *Rubiginosa* is more sharply and distinctly biangulate and produced posteriorly than is *coccinea*. The posterior portion of the ventral margin of *Q. coccinea* is slightly rounded, that of *Q. rubiginosa* is emarginate. *Q. trigona* is distinguished from *Q. coccinea* by its much inflated beaks.

Quadrula solida Lea. Plate LXXXV.

Unio solidus Lea, Trans. Amer. Phil. Soc., vi, 1838, p. 13, pl. v, fig. 13.
Unio fulgidus Lea, Proc. Amer. Phil. Soc., iv, 1845, p. 164.

Shell moderate to large in size, very thick and solid, particularly in region of the beaks, roundly quadrate or triangular, subinflated. Anterior margin flattened above, rather abruptly rounded below; ventral margin almost straight, slightly incurved centrally. Posterior margin straight or curved, sometimes slightly incurved centrally, a little produced ventrally; dorsal margin more or less oblique, straight or curved, sometimes forming one unbroken curve with the posterior margin. Umboidal ratio, from 0.15 to 0.20. Umbones large, full, high, bluntly incurved, directed forward, very slightly ornamented with a few coarse, concentric ridges. Anterior umboidal slope very abruptly curved, in some cases almost straight dorsally; lateral slope fully rounded, bearing a very faint, broad groove extending from the posterior portion of the ventral margin about one-half the distance up the slope; posterior umboidal slope rather abrupt and sometimes slightly excavated. Epidermis smooth in young and rough in old specimens, honey color to black; young specimens ornamented over the umbones with dark green, narrow rays. Lines of growth coarse, crowded, and imbricated. Lunule very large. Ligament long, thick, dark brown.

Interior: Pseudocardinals very heavy, large, erect, ragged, double in the left and single (with sometimes an anterior and a posterior auxiliary) in the right valve; the left pseudocardinals light, running to an edge, arranged in the form of a V or U; the right pseudocardinal broad and truncated and surrounded by a deep V-shaped trench. Interdentum broad, flat, and long. Laterals short, thick, straight or curved, very oblique. Anterior adductor cicatrix elongate, small, deeply pitted, the left one communicating with the trench about the left pseudocardinal. Posterior scars large, deeply impressed, distinct. Dorsal muscle scars arranged in a long row on the lower surface of the pseudocardinals. Pallial line impressed almost its entire length. Cavity of the shell slight, of the beaks deep but compressed. Branchial outline well marked dorsally. Nacre satin-white.

Length.	Breadth.	Height.	Um. ra.	
72.5	52	67	0.16+	(Coll. K. S. A. C.)
70	44	64	.20	(319.1)
68	47	61	.155	(Coll. W. C.)
47	34	42	.15+	(Coll. W. C., juvenile.)

Solida is distributed throughout Mississippi drainage. Locally it is found in the Neosho, the Verdigris and the Walnut rivers, of the southern drainage. It is to be found on gravel-bars and is not a rare species.

Q. solida possesses the most massive shell of any Kansas *Unio*. It is closely related to *Q. coccinea* and *Q. plena*, but it is much more massive and quadrate than either of these forms. The beaks of this form are more elevated than those of *Q. coccinea.*

The pseudocardinals of *solida* are particularly characteristic, being larger in proportion to the size of the shell than any other Kansas *Unio.*

Quadrula plena Lea. Not figured.

Unio plenus Lea, Trans. Amer. Phil. Soc., VIII, 1843, p. 211, pl. XIV, fig. 3.

Shell large, thick particularly anteriorly, inflated in the umboidal region, roundly triangular or ellipsoid in outline. Anterior margin straight or slightly curved above, decidedly curved below; ventral margin straight or very slightly incurved; posterior margin curved, sometimes a little produced below; dorsal margin long, straight, oblique. Umboidal ratio, less than 0.10. Umbones very full, high, incurved and recurved. Anterior umboidal slope very abruptly curved below, incurved above; lateral slope moderately rounded, sometimes bearing a faint, broad radial furrow; posterior slope narrow, abrupt, sometimes slightly incurved. Epidermis shiny over the umbones, dark horn to black in color. Lines of growth prominent. Lunule large, very variable in shape. Ligament rather short, thick, and stout.

Interior: Pseudocardinals low and stumpy, rough and serrate, double in the left valve and single in the right; anterior left pseudocardinal small, often thin, posterior left pseudocardinal a broad truncated pyramid, serrate on top; right pseudocardinal the highest of the set, surrounded by trench. Interdentum broad but very short; laterals very long, slightly curved, not very heavy, continued to the ligament dorsoanteriorly. Anterior adductor cicatrix rather small for the size of the shell, very deeply excavated, quadrant-like in outline, confluent with the anterior retractor cicatrix; posterior scars well impressed, distinct. Pallial line impressed for its anterior two-thirds. Dorsal cicatrices a line on the lower surface of the interdentum. Cavity of the shell rather large, of the beaks moderate. Nacre white or salmon-pink.

Length.	Height.	Breadth.	Um. ra.	
88	62	47	0.06	(317.1)
85	60	44	.09	(460.1)
85	62	47	.045	(Coll. K. S. A. C.)
62	48	37	.06	(461.1)
78	54	45	.08	(462.1)

Q. plena is found in the Ohio, the Cumberland and the Tennessee river drainages, and extends west into Kansas, Indian Territory, and Arkansas. It is found only in the clear-water rivers of the southern drainage in the state. It is fairly common, being found on the gravel-bars of the larger streams. *Plena* varies considerably in its elongation. The older specimens are much longer in proportion to their height than are the younger ones. The shells have either pink or white nacre, in my experience. The form having the pink nacre is the more abundant.

The main differences between this form and *Q. solida* and *Q. ebenus* is noted under the descriptions of those species. *Q. pyramidata* is much more liable to be confused with *plena* than are either of the above species; it is, however, a higher shell, with more elevated umbones and a more flattened or emarginate anterior margin.

Quadrula pyramidata Lea. Not figured.

Unio pyramidatus Lea. Trans. Amer. Phil. Soc., IV, 1834, p. 109, pl. XVI, fig. 39.

Unio mytiloides Deshayes Encyclopédie Méthodique, Historie des Vers, par Bruguière et Lamarck, II, 1830, p. 586, pl. CCXLIX, fig. 4.

Shell moderate in size, heavy, thick anteriorly, much thinner ventro-posteriorly, elliptical, triangular in outline. Anterior margin straight or slightly incurved above, rather abruptly rounded below; ventral margin straight or a little incurved, slightly oblique, short; posterior margin slightly rounded; dorsal margin quite long, oblique. Umboidal ratio, from 0.05 to 0.09. Beaks very much elevated, incurved and decurved. Anterior umboidal slope very abrupt, and bearing a very slight furrow running from the anterior side of the umbones to the upper part of the anterior margin; lateral slope much higher anteriorly than posteriorly, and bearing a narrow, radial flattened area, corresponding in position to the radial furrow in some related forms; posterior slope very abrupt and slightly incurved. Epidermis dark brown, with numerous regular but hardly continuous lines of growth, sometimes possessing a cloth-like texture. Ligament fairly stout and long.

Interior: Pseudocardinals massive, ragged, double in the left and single in the right, the right pseudocardinal arising from a deep pit; laterals long, fairly heavy, very slightly curved, oblique, tending to double in the right as well as in the left valve. Interdentum very short, broad. Anterior adductor cicatrix small, quadrant-like in outline, very deep. Posterior scars much impressed, distinct, the adductor cicatrix broader behind than before. Pallial line well impressed in its anterior half. Dorsal cicatrices a line on the lower surface of the interdentum and the base of the pseudocardinals; cavity of shell moderate, of the beaks shallow and a little compressed; branchial depression deep but not distinctly outlined; nacre a warm pink, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
60	42	41	0.06	(Coll. W. C.)
70	54	44	.085	
32	28	....	.08	

Q. pyramidata is found in the Mississippi drainage, north of the states of Mississippi and Louisiana. It has been reported from the Verdigris and Neosho rivers in Kansas. It has only been reported from two localites, and is apparently a rare species.

There is no species but *Q. plena* that can be confused with *Q. pyramidata*. A discussion of the differences between these two closely related species will be found in the notes on *Q. plena*.

Quadrula ebenus Lea. Not figured.

Unio ebenus Lea, Trans. Amer. Phil. Soc., IV, 1831, p. 84, pl. IX, fig. 14.

Shell of moderate size, solid, broadly elliptical in outline. Anterior margin flatly rounded; ventral margin slightly bowed; posterior margin rounded but sometimes showing a tendency to be biangulate; dorsal margin oblique, straight or slightly curved. Umboidal ratio, 0.10 or less. Umbones full, of moderate height, incurved, and directed anteriorly. Anterior umboidal slope fully curved; lateral slope rather flatly rounded and bearing a radial flattened area, which corresponds with the radial groove present in other closely related species. Posterior slope abrupt and straight. Epidermis smooth and shining over the umbones, dark brown to black. Lines of growth very regular, rounded, and continuous, imbricated marginally. Ligament long, high, dark brown. Lunule small and narrow.

Interior: Pseudocardinals of moderate size, low heavy, ragged, double in the left and single in the right valve. The anterior left pseudocardinal a low, pyramidal ridge joining at a wide angle with the posterior tooth, which is an elongate, truncately pyramidal ridge; right pseudocardinal high and ragged, surrounded by a pit. Interdentum broad and long, depressed in the right valve. Laterals short, thick, oblique, curved. Anterior adductor cicatrix very deep, an elongate quadrant in outline; posterior scars rather small, well impressed, distinct. Dorsal cicatrices on the lower surface of the interdentum forming a line. Pallial line impressed its entire length. Cavity of the beaks and of the shell moderate. Nacre white, slightly iridescent posteriorly.

Length.	Height.	Breadth.	Um. ra.	
72	55	38	0.09	(470.1)

Q. ebenus is found throughout the Mississippi valley generally, except for the northwestern portion. Call reports it from the Kansas river at Topeka. It is also present in the Neosho river at the southern state line and at Burlington.

The shell can be separated from the other heavy *Quadrulas* of its type by its greater compression, less inflated and anteriorly directed beaks, and widely elliptical outline. The outline of all the nearly related forms is roundly triangular.

Two other *Quadrulas* have been reported from Kansas by Call (4), *Q. rubida* Lea and *Q. spherica* Lea. As both these species are confined, except for this one locality, to the eastern streams flowing into the Gulf of Mexico, I withhold them from this catalogue until I have more data concerning them. Simpson (20) states that Call's *Q. rubida* is probably a somewhat sulcate *Q. rubiginosa*.

Key to the Kansas Unionidæ.

This key is a purely local and artificial one. It is intended only to supplement the figures and descriptions in the identification of species.

- I. SHELL ROUGH.
  - A. Shell bearing undulations across the disk.
    - a. Undulations confined to the posterior slope, laterals not present. *Symphynota costata.*
    - b. Laterals present.
      - 1. Umbones high and full. *Quadrula plicata.*
      - 2. Umbones fairly high and full; shell decidedly broader behind than before; plications regular. *Quadrula perplicata.*
      - 3. Umbones compressed.
        - 1¹. Umbones smooth except for slight ridges on their tips. *Quadrula undulata.*
        - 2¹. Umbones very pustulose. *Quadrula heros.*
  - B. Shell ornamented with coarse concentric folds on the lateral slopes, very heavy; beaks placed far forward. *Pleurobema cicatricosum.*
  - C. Shell with a very pronounced umboidal ridge, which is ornamented with several large, irregular nodules.
    - a. Shell decidedly elongate, pseudocardinals small. *Quadrula cylindrica.*
    - b. Shell roundly quadrate, pseudocardinals large. *Quadrula metanevra.*
  - D. Shell elongate with strong umboidal ridge, tubercular anterior, generally brokenly plicate posteriorly. *Tritogonia tuberculata.*
  - E. Shell roundly triangular, lateral slopes bearing a single radial row of erect tubercles 3-5 in number. *Obliquaria reflexa.*
  - F. Shell pustulose.
    - a. Pustules arranged in two radial rows on either side of a shallow radial furrow.
      - 1. Pustules confined to the dorsal half of the disk, shell produced posteriorly. *Pleurobema æsopus.*
      - 2. Pustules generally extending over the surface of the disk, shell quadrate. Group of *Quadrula lachrymosa.*
    - b. Pustules irregularly scattered over the disk, shell sometimes almost epustulate. Group of *Quadrula pustulosa.*
- II. SHELL SMOOTH.
  - A. Neither laterals nor pseudocardinals present.
    - a. Beaks hardly apparent.
      - 1. Shell small and cylindrical. *Anodonta gracilis.*
      - 2. Shell large and circular in outline. *Anodonta suborbiculata.*
    - b. Beaks of moderate inflation and elevation.
      - 1. Shell large, hinge line straight in front of the umbones, relation of length to breadth as 2 is to 1. Group of *Anodonta grandis.*
      - 2. Shell of only moderate size, hinge line slightly incurved in front of the beaks; shell drawn out to a point posteriorly. *Anodontoides ferussacianus.*
    - c. Shell with extremely high and inflated beaks. *Anodonta opaca.*
  - B. Laterals absent, pseudocardinals present as mere rounded knobs. *Steophitus edentulus.*
  - C. Pseudocardinals well developed, laterals indicated only by one low ridge on each valve. Shell often alate. *Symphynota complanata.*
  - D. Laterals and pseudocardinals present.
    - a. Shell alate.
      - 1. Nacre pinkish in the cavity and over the dentition of the shell, pseudocardinals small, rounded knobs. *Lampsilis gracilis.*
      - 2. Nacre deep purple pink all over the interior of the shell.
        - 1¹. Shell very thin, pseudocardinals extremely lamellar. *Lampsilis lævissima.*
        - 2¹. Pseudocardinals of moderate size and typical form; shell square posteriorly. *Lampsilis alata.*
        - 3¹. Shell only slightly alate, inflated, subsolid, pseudocardinals of typical form, epidermis generally black. *Lampsilis purpurata.*

II. Shell Smooth.

D. Laterals and pseudocardinals present.

b. Shell non-alate.

1. Shell thin or at most subsolid, body of shell somewhat or decidedly inflated, rays often present over the disk, pseudocardinals small, sharp-pointed, erect. Interdentum absent or narrow, long, and rounded.

1¹. Shell with moderately high and inflated beaks, two-thirds as high as long, generally yellow with greenish rays, strongly dimorphic.

a¹. Shell small and roundly triangular. *Truncilla triquetra.*

b¹. Shell large and very broadly elliptical, often strongly truncate posteriorly. *Lampsilis ventricosa.*

2¹. Shell with low uninflated beaks.

a¹. Shell roundly triangular, with very erect pseudocardinals and sharp and elevated umboidal ridge.

aa. Shell inflated and almost circularly triangular. *Plagiola elegans.*

bb. Shell rather compressed and elliptically triangular. *Plagiola donaciformis.*

b.¹ Shell elliptical.

aa. Shell small (not over 40 mm. in length), epidermis cloth-like, beaks coarsely undulate.

* Posterior margin rounded. *Lampsilis parva.*

** Posterior margin pointed. *Lampsilis texasensis.*

bb. Shell large.

* Shell very fragile and somewhat compressed, pseudocardinals degenerate.

† Shell obscurely rayed, large, generally yellow, nacre pinkish. *Lampsilis gracilis.*§

†† Shell decidedly rayed, nacre silver white. *Lampsilis leptodon.*

** Shell thin or subsolid, pseudocardinals not degenerate.

† Shell rather broadly elliptical, with a regularly rounded posterior margin.

‡ Shell subsolid, ligament quite large; pseudocardinals large for this group and rounded. Interdentum present. Group of *Lampsilis ligamentina.*

‡‡ Shell fairly thin, pseudocardinals fairly pointed, ligament not large. Interdentum absent or degenerate; females greatly inflated posteriorly. Group of *Lampsilis luteola.*

†† Shell elongate, elliptical pointed posteriorly.

‡ Shell rather compressed, eradiate, epidermis bearing concentric bands of different shades, monomorphic. *Unio tetralasmus.*

‡‡ Shell not compressed, rays present except in the very dark members; color of epidermis not arranged concentrically; dimorphic.

0 Shell rather small (not over 75 mm.), seal brown, umbones covered with many fine widely V-shaped crenulations. *Lampsilis subrostrata.*

00 Shell fairly large, generally polished straw color, with bright green rays. Group of *Lampsilis fallaciosa.*

000 Shell very dark, polished eradiate, nacre white, pink, or purple. *Lampsilis recta.*

II. SHELL SMOOTH.
- D. Laterals and pseudocardinals present.
  - b. Shell non-alate.
    - 2. Shell solid, compressed, beaks low and compressed, pseudocardinals fairly heavy, interdentum present and prominent.
      - a. Shell roundly triangular in outline.
        - a¹. Shell, with broad, green rays, incurved ventral margin and lateral furrow. *Cyprogenia alberti.*
        - b¹. Shell without lateral furrow, ventral margin not incurved. *Plagiola securis.*
      - b. Shell elongately ellipsoid in outline.
        - a¹. Shell broadly or narrowly ellipsoidal; epidermis light to dark brown, with fine hair rays posteriorly; beaks with very fine crenulations. Groups of *Phychobranchus phaseolus.*
        - b¹. Shell generally narrowly elliptical; epidermis dark brown or black, eradiate; beak sculpture a few very coarse concentric folds; nacre white, pink, or purple. *Unio gibbosus.*
      - c. Shell quadrate, sometimes with green rays over the umbones. *Quadrula rubiginosa.*
    - 3. Shell roundly elliptical, triangular or quadrate, inflated in the umboidal region or just posterior to it, solid, pseudocardinals heavy and ragged, the right pseudocardinal surrounded by a trench.
      - a. Shell fairly solid, roundly triangular or quadrate, beaks not high. Group of *Quadrula trigona.*
      - b. Shell solid, roundly elliptical, beaks not high.
        - a¹. Beaks full but not high; epidermis honey-brown with sometimes a greenish cast. *Obovaria ellipsis.*
        - b¹. Beaks rather compressed; epidermis very dark brown or black. *Quadrula ebenus.*
      - c. Shell roundly triangular, high, with full, high, rounded, incurved beaks, very solid, with very large pseudocardinals. Group of *Quadrula plena.*
      - d. Shell suborbicular, heavy, large, with rather full, high beaks. *Quadrula houstonensis.* (This will also include the smooth, circular forms of *Q. pustulosa.*)

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§ This is intended as check on the forms of *L. gracilis* which have lost their alæ.

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† Received while paper was in press.

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Zoological Laboratory, University of Kansas, March 3, 1906.

Erratum.—For bibliographical reference 24, read *Joul. Cinn. Soc. Nat. Hist., 1906*, instead of "Joul. Cinn. Acad. Sci., 1906."

THE
KANSAS UNIVERSITY
SCIENCE BULLETIN.

Vol. III, No. 10—April, 1906.
(Whole Series, Vol. XIII, No. 10.)

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Coal Measures Faunal Studies, IV.
J. W. Beede and Austin F. Rogers.

PUBLISHED BY THE UNIVERSITY,
Lawrence, Kan.

Entered at the post-office in Lawrence as second-class matter.

KANSAS UNIVERSITY SCIENCE BULLETIN.

VOL. III, No. 10. APRIL, 1906. { WHOLE SERIES, VOL XIII, NO. 10.

COAL MEASURES FAUNAL STUDIES, IV.

UPPER COAL MEASURES, Neosho River Section.

BY J. W. BEEDE AND AUSTIN F. ROGERS.*

THIS paper is a continuation of the others of similar title by the authors, and takes up the rocks of the southeastern part of the state where No. III left off, (No. 15, vol. II).

DUDLEY SHALES.

One hundred and fifty feet of shales from which no fossils have, with certainty, been collected. Some were collected from clay shales at Parsons, but we are not certain of the horizon from which they came.

HERTHA LIMESTONE.

Bluish to light gray limestone with shale partings. From ten to twenty feet in thickness. The fossils accredited to this limestone were collected from the Santa Fe railroad cut just east of Trent siding, three miles east of Erie.

Sponge?.
Aulopora sp.
Axophyllum rude White and St. John, c.
sp.
Campophyllum torquium Owen.
Lophophyllum westii Beede, aa.
Crinoid plates and stems.
Archæocidaris, two or three species.
Serpula insita White.
Spirorbis cf. nodulosus Hall.
sp.
Hederella ? sp., a.
Chainodictyon laxum Foerste.
Cystodictya inequimarginata Rogers.
Fenestella limbata Foerste.
sp.
Fistulipora nodulifera Meek.
Pinnatopora sp.
Polypora, two species.
Rhombocladia delicata Rogers, c.
Rhombopora lepidodendroides Meek.
Stenopora carbonaria Worthen.
Ambocœlia planoconvexa (Shumard), c.

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- Chonetes flemmingi Norwood and Pratten, a.
- Crania sp., c.
- Derbya crassa (Meek).
  - keokuk (Hall)?.
- Dielasma bovidens (Morton), c.
- Orbiculoidea convexa (Shumard).
- Productus cora d'Orbigny.
  - longispinus (Sowerby), aa.
  - nebrascensis Owen.
  - pertenuis Meek, c.
  - punctatus (Martin).
  - semireticulatus (Martin).
- Pugnax rockymontanus (Marcou)?.
  - utah (Marcou).
- Reticularia perplexa (McChesney).
- Rhipidomella pecosi (Marcou).
- Seminula argentea (Shepard), c.
- Spirifer cameratus Morton, c.
- Spiriferina kentuckiensis (Shumard).
- Aviculopecten carboniferus (Stevens).
  - maccoyi Meek.
- Aviculopinna illinoisensis Worthen.
- Conocardium parrishi Worthen.
- Edmondia ? sp.
- Limopteria longispina (Cox).
- Pelecypod sp.
  - pinna-like.
- Pernopecten sp.
- Pseudomonotis sp.
- Pteria longa (Geinitz) ??.
- Bellerophon carbonarius (Cox).
  - percarinatus Norwood and Pratten.
- Bulimorpha sp.
- Gastropods, two or three species.
- Pleurotomaria missouriensis Meek and Worthen.
  - two species.
- Strophostylus nanus (Meek and Worthen).
  - two species.
- Trachydomia wheeleri (Swallow).
- Cephalopod sp.
- Ephippoceras ferratus (Cox) ??.
- Metacoceras sangamonensis (Meek and Worthen) ?.
- Orthoceras sp.
- Cyclus packardi Rogers.
- Cypridina sp.
- Cypridella sp.
- Fish tooth.
- Peripristis semicircularis (Meek) ?.

MOUND VALLEY LIMESTONE.

A limestone in several layers, aggregating ten or fifteen feet in thickness. The layers are separated by shaly partings. The fossils accredited to this horizon were collected from two localities, as follows: One on the west side of the Neosho river, where the wagon road leading west from the bridge just south of Erie rises from the river bottom; several layers are exposed in the road. The other locality is in the A. T & S. F. railroad cut at the foot of the bluff about three miles west of Erie. The limestone is on the north side, near the track. At this point the layers are rather massive.

ROAD WEST OF RIVER.

- Sponge sp.
- Fenestella limbata Foerste.
- Fistulipora nodulifera Meek.
- Polypora sp.
- Dielasma bovidens (Morton).
- Productus cora d'Orbigny, c.
  - costatus (Sowerby).
  - nebrascensis (Owen), c.
  - pertenuis Meek.
- Productus punctatus (Martin).
  - semireticulatus (Martin).
- Reticularia perplexa (McChesney), c.
- Seminula argentea (Shepard).
- Spirifer cameratus (Morton).
- Cypridina sp.
- Cypridella sp.
- Ostracod.

CUT WEST OF TOWN.

- Lophophyllum westii Beede.
- Archæocidaris sp.
- Spirorbis cf. blairii Miller.
- Fenestella sp.
- Fistulipora nodulifera, c.
- Pinnatopora sp.
- Polypora elliptica Rogers, c.
  - three species.
- Rhombocladia delicata Rogers.
- Rhombopora sp.
- Septopora biserialis (Swallow).
- Stenopora carbonaria Worthen, c.
- Derbya crassa (Meek and Hayden), c.
  - keokuk Hall.
- Meekella striaticostata (McChesney)?.
- Productus cora d'Orbigny, a.
  - longispinus (Sowerby).
  - nebrascensis Owen.
  - pertenuis Meek.
  - punctatus (Martin).
  - sp.
- Reticularia perplexa (McChesney).
- Seminula argentea (Shepard), aa.
- Spirifer cameratus Morton, a.
- Spiriferina kentuckiensis (Shum.), a.
- Strophalosia spondyliformis White and St. John.
- Allorisma sp.
- Aviculopecten carboniferus (Stev.)
  - two species.
- Edmondia sp.
- Entolium aviculatum Swallow.
- Lima retifera Shumard.
  - sp.
- Myalina subquadrata Shumard, c.
  - swallowi McChesney.
- Pleurophorus, two species.
- Pseudomonotis kansasensis Beede?.
- Pteria longa (Geinitz).
- Schizodus curtiforme Walcott?.
- Solenomya radiata Meek and Worthen.
- Bellerophon sp.
- Bulimorpha cf. nitidula (M. & W.)
  - sp.
- Loxonema sp.
- Pleurotomaria sp.
- Soleniscus?, two species.
- Strophostylus sp.
- Straparollus sp.
- Nautiloid.
- Cypridina sp.
- Phillipsia major Shumard.

DUDLEY SHALES.

From a few to a hundred feet in thickness. No fossils have been collected from these shales.

DENNIS LIMESTONE.

A light gray limestone, reaching a thickness of forty feet. Fossils were taken from this limestone from two localities—one at the top of the bluff at the A. T. & S. F. cut, west of Erie; and the other from the cut by same road just west of Shaw. These localities are so close and the possibility for mistake in the horizon so great that they are here grouped together.

- Sponge? sp.
- Lophophyllum westii Beede.
- Archæocidaris megastylus Shumard.
  - sp.
- Cystodictya inequimarginata Rogers, c.
- Fenestella limbata Foerste, c.
  - remota Foerste.
  - sp.
- Fistulipora nodulifera Meek.
- Pinnatopora multipora Rogers.
  - trilineata (Meek).

- Polypora elliptica Rogers.
  - sp.
- Rhombocladia delicata Rogers.
- Rhombopora sp., c.
- Stenopora carbonaria Worthen, c.
- Cleiothyris roissyi l'Eveille.
- Crania modesta White and St. John.
- Derbya crassa (Meek and Hayden).
- Dielasma bovidens (Morton).
- Hustedia mormoni (Marcou).
- Proboscidella sp., a.
  - sp.
- Productus costatus (Sowerby), a.
  - longispinus (Sowerby), aa.
  - muricatus Norwood and Pratten.
  - nebrascensis Owen.
  - pertenuis Meek, c.
  - punctatus (Martin), c.
- Reticularia perplexa (McChesney), aa.
- Seminula argentea (Shepard), aa.
- Spirifer cameratus (Morton), c.
- Spiriferina kentuckiensis (Shumard).
- Allorisma granosum Shumard.
- Aviculopecten carboniferus (Stev.)
  - hertzeri Meek.
  - occidentalis Shumard.
  - providencesis Cox.
- Chænomya leavenworthensis Meek and Hayden.*
- Concocardium parrishi Worthen.
- Edmondia aspinwallensis Meek?.
- Edmondia? sp.
- Macrodon sangamonensis Worthen?.
- Pleurophorus tropidophorus Meek.
- Anomphalus rotulus M. & W.?
- Bellerophon crassus M. & W.?
  - sp.
- Euomphalus catilloides (Conrad).
- Gastropod sp.
- Pleurotomaria missouriensis Shum.*
  - tenuistriata Shum.
- Strophostylus sp.
- Ephippoceras? sp.
- Orthoceras cribosum Geinitz.
- Temnocheilus? sp.
- Cypridella sp.
- Cyrpidina sp.
- Eutomis sp.

CHANUTE SHALES.

About 200 feet of shales with some sandstone. No fossils were collected from this horizon.

IOLA LIMESTONE.

Thirty feet of gray to almost white limestone. The fossils accredited to this horizon were from two localities—Chanute and the cement quarries at Iola. The studies of Professor Haworth and Doctor Adams led them to the conclusion that the limestone just west of Chanute was the base of the Iola limestone. The difference between the faunas of the Iola exposure and this one is so striking that they are given separately here.

ABOUT ONE MILE WEST OF CHANUTE.

- Sponge? sp.
- Lophophyllum westii Beede.
- Archæocidaris sp.
- Fenestella sp.
- Fistulipora nodulifera Meek, c.
- Polypora elliptica Rogers.
  - sp.
- Rhombocladia delicata Rogers.
- Ambocœlia planoconvexa (Shumard), a.

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* This specimen was taken from the ballast in the cut, but is unquestionably from the limestone in which the cut is made.

- Chonetes verneuilianus Norwood and Pratten.
- Cleiothyris roissyi l'Eveille, ? c.
- Cryptacanthia compacta White and St. John, a.
- Derbya sp.
- Dielasma bovidens (Morton).
- Hustedia mormoni (Marcou).
- Meekella striaticostata (McChesney), aa.
- Productus pertenuis Meek.
  - punctatus (Martin).
  - semireticulatus (Martin).
  - sp.
- Recticularia perplexa (McChesney), aa.
- Seminula argentea (Shepard), a.
- Spirifer cameratus Morton.
- Spiriferina kentuckiensis (Shumard), aa.
- Aviculopecten interlineatus Meek and Worthen.
- Pelecypod sp.
- Bulimorpha sp.
- Capulus parvus Swallow.
- Gastropod sp.

CEMENT WORKS AT IOLA.

- Lophophyllum profundum (E. & H.), c.
  - westii Beede, aa.
- Ceriocrinus missouriensis M. & G., c.
- Ceriocrinus? sp.
- Crinoid sp.
- Erisocrinus typus M. & W.?, a.
- Hydreionocrinus discus (M. & W.)?.
- Phialocrinus? sp.
- Serpula insita White.
- Spirorbis blairii Miller.?
- Cystodictya inequimarginata Rogers.
- Fenestella limbata Foerste.
  - sp.
- Fistulipora nodulifera Meek, aa.
- Pinnatopora sp.
- Polypora elliptica Rogers, c.
  - sp.
- Rhombopora sp.
- Rhombocladia delicata Rogers.
- Septopora biserialis (Swallow).
- Stenopora carbonaria Worthen.
- Chonetes verneuilianus N. & P., c.
- Cleiothyris roissyi l'Eveille.
- Derbya crassa (Meek).
- Dielasma bovidens (Morton), c.
- Hustedia mormoni (Marcou), aa.
- Meekella striaticostata (McChes.)
- Proboscidella sp.
- Productus cora d'Orbigny.
  - longispinus (Sowerby), aa.
  - pertenuis Meek, c.
  - punctatus (Martin).
- Pugnax utah (Marcou).
  - sp.
- Reticularia perplexa (McChesney), c.
- Seminula argentea (Shepard), a.
- Spirifer cameratus Morton, c.
- Spiriferina kentuckiensis (Shumard), aa.
- Strophalosia spondyliformis (White and St. John?).
- Allorisma granosum (Shumard).
- Aviculopecten interlineatus Meek and Worthen.
- Entolium aviculatum (Swallow).
- Lima retifera Shumard.
  - sp.
- Macrodon sangamonensis Worthen?.
- Modiola sp.
- Bulimorpha cf. chrysalis Meek and Worthen.
- Capulus parvus Swallow, c.
  - sp.
- Gastropod, two species.
- Trachydomia wheeleri (Swallow)?.
- Milleroceras parishi Miller and Gurley?.
- Nautiloid.
- Orthoceras sp.
- Cypridina sp.
- Cypridella sp.
- Griffithides scitula (Meek and Worthen).
- Phillipsia? sp.*

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*Girty states (Bull. 211, U. S. G. S., p. 75), " . . . *Enteletes* first appears in the Iola limestone, where it is abundant. . . ." As a matter of fact it should be stated that three days' collecting at the type locality, by the authors, failed to reveal a single specimen of this fossil. One of the authors, whose home was in Kansas City, on the ledge of the Iola limestone, during years of collecting, never saw a specimen of it in that horizon. It is altogether probable that, in time, it will be found in the Iola limestone, as in the next heavy

LANE SHALES.

About seventy-five feet of bluish shales, nearly non-fossiliferous save in some calcareous layers near their base. The fossils from this horizon were collected in these calcareous layers in the base of the shales at the brick-yards south of Iola.

Amblysiphonella? sp.
Sponges?, two species.
Lophophyllum profundum (Edwards and Haime).
  westii Beede?.
Ceriocrinus? sp.
Crinoid sp.
Erisocrinus typus Meek and Worthen.
Fenestella sp.
Polypora sp.
Ambocœlia planoconvexa (Shumard).
Chonetes verneuilianus Norwood and Pratten.
Hustedia mormoni (Marcou), c.
Productus longispinus (Sowerby).
  nebrascensis Owen.
Pugnax utah (Marcou).
Reticularia perplexa (McChesney).
Spirifer cameratus (Morton), c.
Spiriferina kentuckiensis (Shumard).
Aviculopecten occidentalis (Shumard).
Capulus parvus Swallow.
Naticopsis? sp.
Pleurotomaria sp.
Agassizodus variabilis Newberry and Worthen?.

ALLEN AND STANTON LIMESTONE AND OTHER FORMATIONS.

At the time of our visit the stratigraphy of the region north of Iola was not yet sufficiently well worked out to permit of collecting to the best advantage. All the formations above the Iola limestone, or their equivalents, are very much better exposed and vastly more fossiliferous and easily accessible along the Kansas river west from Kansas City. Any one desiring any adequate knowledge from a limited study of these formations and their faunas should confine their observations to the Kansas river section, if we except region around Cottonwood Falls. Under the above heading we include the limestones and shales above the Iola and below the Upper Oread at Burlington. The limestone forming an escarpment some few miles south of Burlington was not visited. Collections were made at the Allen limestone on top of the Lane shales at the Iola brick-yards, where twenty-eight of the following species were represented. The forms referred to as sponges in the list were confined to this locality. The rocks (three

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persistent limestone above (the Garnett) it is extremely abundant. However, we have never seen it below that horizon. It should also be stated that Adams, who made the collections upon which Girty based his lists, admitted to the authors in the field that the specimens of *Enteletes* from Iola were collected from the ballast of the railroad at that place. That ballast was crushed at Garnett, from the Garnett limestone, in which it is very abundant. Consequently Girty's statement concerning it in Professional Paper No. 16, U. S. G. S., p. 264, and other places, is in error.

limestone horizons) at Carlyle contained representatives of fourteen of them, while a locality just a few miles west of Carlyle and south of east of Neosho Falls contained twenty of them. They are grouped here in one list, on account of the difficulty of correlation of horizons.

Fusulina sp.
Amblysiphonella? sp., aa.
Sponge? sp., large, a.
Sponge?, two small species, aa.
Lophophyllum profundum (Edwards and Haime).
westii Beede, a.
Ceriocrinus missouriensis Miller and Gurley.
Crinoid sp.
Erisocrinus typus Meek and Worthen?.
Phialocrinus stillativus (White)?.
Archæocidaris sp.
Fenestella sp.
Fistulipora nodulifera Meek.
Polypora elliptica Rogers.
submarginata Meek.
Rhombopora sp.
Septopora biserialis (Swallow).
Chonetes flemmingi Norwood and Pratten.
Derbya crassa (Meek).
sp.
Dielasma bovidens (Morton).
Enteletes hemiplicatus Hall, c.
Hustedia mormoni (Marcou), a.
Productus longispinus (Sowerby), a.
nebrascensis Owen.
punctatus (Martin), c.
sp.
symmetricus McChesney.
Pugnax utah (Marcou).
Reticularia perplexa (McChesney).
Rhipidomella pecosi (Marcou).
Seminula argentea (Shepard), aa.
Spirifer cameratus Morton. c.
Spiriferina kentuckiensis (Shumard), c.
Aviculopecten occidentalis (Shumard)?.
Entolium aviculatum (Swallow).
Myalina sp.
subquadrata Shumard?.
Nuculana bellistriata (Stevens).
Pelecypod sp.
Euomphalus sp.
Cephalopod sp.
Orthoceras sp.
Cladodus sp.

OREAD LIMESTONE.

The exposures at Burlington do not show the thickness of the Oread limestone nor the succession of layers. The portion collected from is probably the upper stratum, exposed in the city and in an old quarry two miles south of town, on the east side of the M. K. & T. railroad, by a little creek.

Fusulina sp.
Amblysiphonella? sp.
Sponge, two species, aa.
Aulopora? anna Beede?.
Lophophyllum profundum E. & H. ?
westii Beede, c.
Ceriocrinus missouriensis Miller and Gurley, c.
Hydreionocrinus discus M. & W.?
Crinoids, two or three species.
Archæocidaris sp.
Serpula insita White.
Cystodictya inequimarginata Rogers.
Fenestella limbata Foerste.
remota Foerste.
sp.
Fistulipora nodulifera Meek, a.
Pinnatopora whitei Foerste.
Polypora aspera? Rogers.
elliptica Rogers.
submarginata Meek.
Rhombocladia delicata Rogers.
Rhombopora sp.
Septopora biserialis (Swallow).

- Stenopora carbonaria Worthen, c.
- Streblotrypa prisca (Gabb and Horn).
- Ambocœlia planoconvexa (Shum.), c.
- Chonetes flemmingi N. & P.
  - granulifer Owen, c.
- Derbya bennetti Hall and Clarke.
  - crassa (Meek).
  - keokuk (Hall).
- Dielasma bovidens (Morton).
- Enteletes hemiplicata Hall.
- Hustedia mormoni (Marcou), a.
- Meekella striaticostata (McChes.)
- Proboscidella sp.
- Productus cora d'Orbigny.
  - longispinus (Sowerby), a.
  - nebrascensis Owen.
  - pertenuis Meek, a.
  - punctatus (Martin).
  - semireticulatus (Martin).
- Productus sp., c.
- Pugnax utah (Marcou), c.
- Reticularia perplexa (McChesney).
- Rhipidomella pecosi (Marcou), a.
  - pecosi var.
- Seminula argentea (Shepard), c.
- Spirifer cameratus (Morton), c.
- Spiriferina kentuckiensis (Shumard).
- Nucula ventricosa Hall.
- Gastropod sp.
- Orthonema salteri Meek and Worthen ?.
- Pleurotomaria sp.
  - sphærulata Conrad ?.
- Orthoceras cribosum Geinitz, c.
- Cypridina sp.
- Cypridella sp.
- Griffithides scitula Meek and Worthen.

EMPORIA LIMESTONE.

The interval between the Oread and Emporia limestones along the Neosho river is not well available for collecting purposes and was omitted. This region can be better studied on the Kansas river, which is probably not sufficiently distant to affect its fauna greatly. There are about three strata of limestone with thin shales between exposed in the northeast part of Emporia. While the fossils from the three horizons were kept separate, the lists are here combined.

- Fusulina sp., c.
- Sponge ? sp.
- Lophophyllum westii Beede.
- Fistulipora nodulifera Meek.
- Rhombopora sp.
- Ambocœlia planoconvexa (Shumard), aa.
- Chonetes granulifer Owen.
- Hustedia mormoni (Marcou).
- Productus semireticulatus (Martin).
  - sp.
- Spirifer cameratus Morton, c.
- Spiriferina kentuckiensis (Shumard).
- Nuculana bellistriata attenuata Meek, a.
- Bellerophon bellus Keyes ?.
- Gastropod, two species.
- Loxonema sp.
- Murchisonia sp.
- Naticopsis altonensis McChesney ?.
- Pleurotomaria brazoensis Shumard ?.
  - perhumerosa Meek, aa
- Soleniscus ? sp.
- Strophostylus nanus (M. & W.) ?, c.
- Aganides sp., c.
- Gastrioceras sp., a.

ELMDALE FORMATION.

The following is a rough section measured rapidly for the purpose of assigning definite horizons for the fossils collected:

	Feet.	Inches.
22. Limestone (Neva)	4+	...
21. Shales	8	...
20. Impure limestone	1	6
19. Shale	3	8
18. Slabby limestone	5	...
17. Blue, shaly limestone	2	4
16. Hard, calcareous shale	3	...
15. Slabby limestone	5	...
14. Olive shales	7	...
13. Blocky stuff	3	...
12. Clay with crusty sheets	2	2
11. Shale	5	...
10. Limestone	6	...
9. Shales	2	...
8. Clayey limestone	0	8
7. Green shales	8	...
6. Thinly bedded buff limestone, with crusty seams	3	...
5. Olive shales	4	6
4. Limestone	0	4
3. Shales	2	...
2. Limestone	1	2
1. Shale	2	...

The lowest number (1) is well up in the formation. The remaining portion is not exposed in place, and, indeed, none of it but the *Fusulina* zone is exposed at all. No. 1 is the lowest shale, shown in the road just east of the bridge. The formation is considered as running down to the water's edge below the bridge. The rock on which the dam is built is probably the Americus limestone. The *Fusulina* horizon is considerably above this, and about an equal amount below the base of the section given. The section is located at the type locality of the formation, on the Cottonwood Falls road at the river bluff east of Elmdale.

FUSULINA HORIZON.

Fusulina sp., aa.
Lophophyllum profundum E. & H.
Crinoid spines, two species.
Archæocidaris spinoclavata M. & W.
    triserrata Meek.
    two species.
Fenestella sp.
Fistulipora nodulifera Meek.
Meekopora prossseri Ulrich.
Rhombopora sp.
Septopora biserialis (Swallow).
Chonetes glaber Geinitz.
    granulifer Owen.
Hustedia mormoni (Marcou).
Productus sp.

Pugnax utah (Marcou).
Rhipidomella pecosi (Marcou).
Seminula argentea (Shepard), c.
Spirifer cameratus Morton.
Spiriferina kentuckiensis (Shumard).

No. 10.

Archæocidaris sp.
Fenestella sp.
Ambocœlia planoconvexa (Shumard).
Chonetes sp.
Hustedia mormoni (Marcou).
Meekella striaticostata (McChes.)
Pugnax utah (Marcou).
Seminula argentea (Shepard).

No. 11.

Fusulina sp.
Aulopora? anna Beede.
Archæocidaris sp.
Fistulipora nodulifera Meek.
Meekopora prosseri Ulrich.
Septopora biserialis (Swallow).
Chonetes granulifer Owen.
Hustedia mormoni (Marcou).
Productus semireticulatus (Martin), c.
Pugnax utah (Marcou), c.
Seminula argentea (Shepard), c.
Spirifer cameratus (Morton), c.

No. 15.

Productus nebrascensis Owen.
Aviculopecten occidentalis Shum., a.
maccoyi M. and H.
Pseudomonotis hawni (Meek), a.

No. 17.

Fenestella sp.
Rhombopora sp.
Septopora biserialis (Swallow).
Streblotrypa prisca (Gabb and Horn).
Derbya crassa (Meek).
Productus nebrascensis Owen.
Seminula argentea (Shepard), c.
Aviculopecten occidentalis Shumard.
Myalina sp.

NEVA LIMESTONE.

A comparatively thin limestone, in two layers, aggregating about ten feet in thickness. Locality, top of previous section (22).

Fusulina sp.
Pinnatopora sp.
Ambocœlia planoconvexa (Shumard).
Seminula argentea (Shepard).

ESKRIDGE SHALES.

About thirty feet of non-fossiliferous shales.

COTTONWOOD LIMESTONE.

Six feet or more of white, slightly cherty, foraminiferal limestone, in two layers. Quarries east of Cottonwood Falls.

Fusulina sp., aa.
Lophophyllum profundum Milne, Edwards and Haime.
Archæocidaris sp.
Cystodictya inequimarginata Rogers.
Fenestella limbata Foerste.
remota Foerste.
Fistulipora nodulifera Meek.
Pinnatopora sp.
Rhabdomeson americanum Rogers.
Rhombopora lepidodendroides Meek.
Septopora biserialis (Swallow).
Streblotrypa prisca (Gabb and Horn).
Chonetes granulifer Owen.
Pinna sp.
Griffithides scitula (Meek and Worthen).

Florena Member, Garrison Formation.—Calcareous, highly fossiliferous shales from six to ten feet in thickness, resting on the Cottonwood limestone. Quarries east of Cottonwood Falls.

Fusulina sp.
Lophophyllum profundum (Edwards and Haime).
Ceriocrinus hemisphæricus (Shumard).
Archæocidaris sp.
Fenestella limbata Foerste, c.
    remota Foerste.
Fistulipora nodulifera Meek, c.
Meekopora prosseri Ulrich, c.
Pinnatopora sp.
Rhombopora lepidodendroides Meek.
Septopora biserialis (Swallow), a.
Stenopora carbonaria Worthen, c.
Streblotrypa prisca (Gabb and Horn).
Thamniscus octonarius Ulrich, c.
Chonetes granulifer Owen, aa.
Crania modesta White and St. John.
Derbya crassa (Meek).
    sp.
Meekella striaticostata (McChesney), c.
Productus cora d'Orbigny.
    longispinus (Sowerby).
    nebrascensis Owen, c.
    semireticulatus (Martin), a.
    sp.
Seminula argentea (Shepard), a.
Strophalosia sp.
Astartella sp.
Aviculopecten maccoyi Meek and Hayden.
Euomphalus sp.
Griffithides scitula (Meek and Worthen).

Neosho Member, Garrison Formation.—A series of shales and thin limestones about 100 feet thick.

	Section at Crusher Hill, near Strong City.	Feet.	Inches.
16.	Covered slope, with red and green shales at top	40	...
15.	Limestone with interbedded shales	10	...
14.	Shales	10	...
13.	Greenish shales, with stratified limestones	5	...
12.	Calcareous slabby shales	8	...
11.	Limestone	1	8
10.	Shales, lower part gray, upper part buff	5	...
9.	Limestone	2	...
8.	Shales, red, green, and buff	6	6
7.	Buff concretionary rock	0	6
6.	Bituminous and blue shales	10	...
5.	Limestone	2	6
4.	Shales with limestone streaks	12	...
3.	Clayey, blocky limestone	0	5
2.	Greenish shales	5	6
1.	Limestone	2	...

The fossils of these horizons are here grouped in a single list.

Crinoid sp.
Archæocidaris sp.
Fenestella limbata Foerste.
Rhombopora sp., a.
Septopora biserialis (Swallow), c.
Stenopora carbonaria (Worthen), c.
Streblotrypa prisca (Gabb and Horn).
Thamniscus octonarius Ulrich, c.
Spirorbis sp., a.
Chonetes granulifer Owen, aa.
Derbya sp.
Meekella striaticostata (McChesney).
Productus nebrascensis Owen.
  semireticulatus (Martin).
Seminula argentea (Shepard).
Aviculopecten occidentalis Shumard, c.
Pelecypod sp.
Pseudomonotis hawni (Meek and Worthen).
Aclis ? sp.
Bellerophon sp.
Gastropod, several species.
Griffithides scitula (Meek and Worthen).

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PLATE I.

Some mouth-parts of *Lachnus longistigma.*

FIGURE 1.

Cephalic view of the head and ventral view of the labium.

A.—First two segments of the antennæ.
B.—Frontal ocellus, situated in the epicranium.
C.—Compound eye.
O.—Ocular tubercle.
D.—Frons.
E.—Clypeus.
F.—Basal sclerite of mandibular setæ.
G.—Labrum.
H.—Labium.
I.—Mandibular setæ separated.
J.—Maxillary setæ not separated.

Setæ are all slightly displaced for the sake of illustration. 1, 2 and 3 are the first, second and third joints of the labium, respectively.

FIGURE 2.

Ventral view of the labrum.

A.—Epipharynx.
B.—Chitinized rod formed by the approximation of the lateral folds or margins of the labrum.

FIGURE 3.

Dorsal view of a mandibular seta.

A.—Muscular attachment of setæ.
B.—The basal sclerite.
C.—Greatly enlarged distal point of the same seta or stylet.
D.—Lumen.

FIGURE 4.

Ventral view of the labium with the setæ removed and the canal open.

A.—Antelabial sclerite.
B.—Median chitinized floor which supports the maxillary setæ.
C.—Chitinized lines which support the mandibular setæ.
D.—The chitinized floors are in the canal which becomes eliminated at this place on account of the profunal bend in the labium.

FIGURE 5.

Cross-section of the first joint of the labium with the setæ removed, canal closed.

A.—Chitinized floor.
B.—Chitinized wall.
C.—The labial canal in which the setæ may be held.
D, E.—Paired tongues and grooves, respectively, which firmly lock the two lateral edges of the canal together when the insect is drilling into its host-plant. This connection is more perfect nearer the distal end of the canal.
F.—Outer margin of the labium.
G.—Some of the musculature.

FIGURE 6.

Cross-section of the labial canal with the setæ in place.

A.—Chitinized floor.
B.—Chitinized wall.
C.—Labial canal.
D.—Mandibular stylet.
E.—Lumen in mandibular stylet.
F.—Maxillary stylet.
G.—Lumen in the maxillary stylet.
H.—Tube through which the food is taken.

PLATE I.

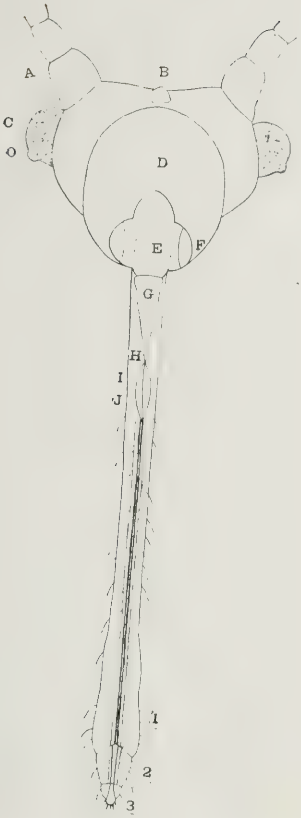
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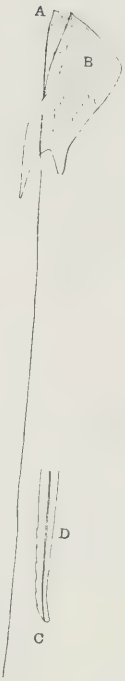
Fig 1



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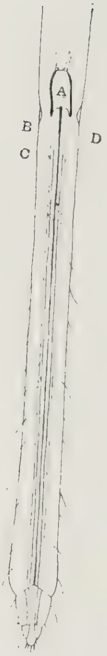

Fig. 4.

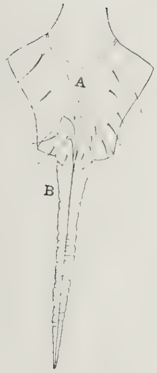

Fig 2

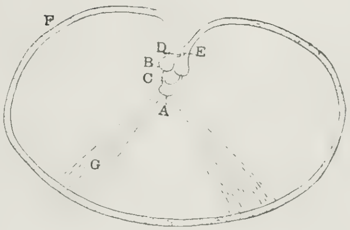

Fig 5

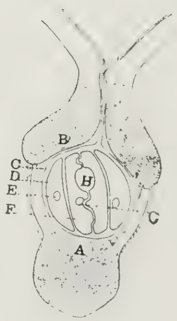

Fig 6.

PLATE II.

FIGURE 7.

Schizoneura lanigera.

A.—Wax glands.

B.—Tubercular type of honey-tube which is almost obsolete.

C.—Style which is abnormally exserted. Normal in this case when only the knob can be seen.

D.—Knob which when normal is called subobsolete.

E.—Some of the dorsal musculature.

FIGURE 8.

Wax glands of figure 7, enlarged, showing the arrangement of the cells.

FIGURE 9.

Wax gland of a Pemphigina, showing a different number and size of cells than *Schizoneura.*

FIGURE 10.

Honey-tube of *Macrosiphum.* Cylindrical honey-tube which is slightly dilated at the distal end.

A.—Proximal end, or base.*

B.—Distal end, or tip.*

C.—Strong imbrication.

FIGURE 11.

Honey-tube of *Rhopalosiphum.* An incrassate form.

FIGURE 12.

Honey-tube of a *Melanoxanthus.* Vasiform honey-tube of the incrassate type.

FIGURE 13.

Honey-tube of a *Drepanosiphum.* An incrassate honey-tube which is dilated at the base.

FIGURE 14.

A clavate honey-tube.

E.—Weak imbrication.

FIGURE 15.

Style of a *Nectarophorini.* An ensiform type.

A.—Proximal end, or base.†

B.—Distal end, or tip.†

C.—A setaceous hair.

D.—Small spinous processes.

FIGURE 16.

Style of an Aphidinæ. A conical type.

FIGURE 17.

Style of a *Callipterini.* A globular type.

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*These two points also indicate the places between which the measurement is taken for this text.

†These two points also indicate the places between which the measurement of length is taken, as given in this text.

PLATE II.

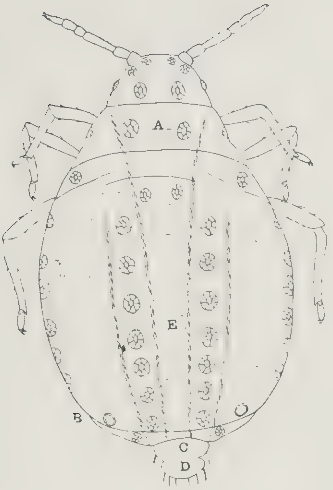
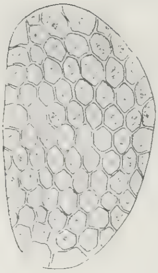


Fig. 7



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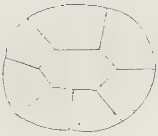

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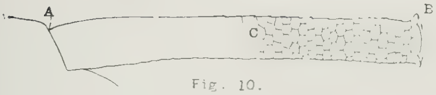

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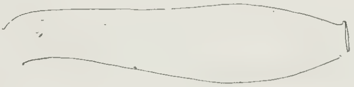


Fig. 11

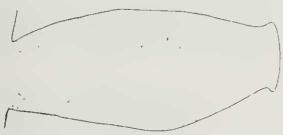
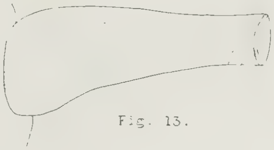


Fig. 12



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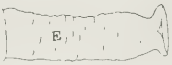

Fig. 14

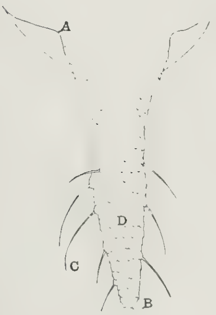

Fig. 15

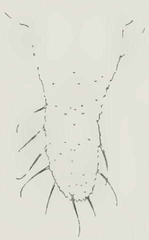

Fig. 16.

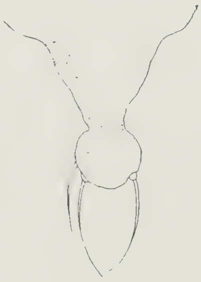

Fig. 17.

PLATE III.

This plate illustrates the relative positions of the veins in the subfamilies of the Aphididæ; and in addition is explained the nomenclature bearing on this subject as used in the text.

Figure 18.

Subfamily Lachninæ. *Lachnus longistigma.*

This is the largest wing in the entire family. Another special feature is the extent of the stima and stigmal cell proper, which in the stigma is distinctly bounded distally at A, while the stigmatic coloration extends around to the apical margin, I.

Figure 19.

Subfamily Aphidinæ. *Aphis brassicæ.*

A is the front or cephalic wing. B is the caudal or hind wing. These letters also represent the wing insertions. In the following the same letters apply to each wing:

1.—Costa or costal vein.
2.—Subcostal vein or cubitus.
3.—First discoidal vein.
4.—Second discoidal vein.
5.—Third discoidal vein.
6.—Second branch.
7.—First branch.
8.—Stigmatic vein.
9.—Stigma.
10.—Fold for hooklet.
11.—Hooklet.

A.—Costal cell.
B.—Basal cell.
C.—First discoidal cell.
D.—Second discoidal cell.
E.—First cubital cell.
F.—Second cubital cell.
G.—Inframarginal cell.
H.—Marginal or stigmal cell.
I.—Apical margin or apex.
G and H are also known as apical cells.

Figure 20.

Subfamily Schizoneurinæ. *Schizoneura lanigera.*

The points A and B are the points from which the measurements of breadth are taken, and the letters C and D the points from which the measurement of length of the stigma is taken.

Figure 21.

Subfamily Pemphiginæ. *Pemphigus populitransversus.*

Figure 22.

Subfamily Chermisinæ. *Phylloxera.*

Figures 23 and 24.

Subfamily Aphidinæ.

These figures illustrate some of the anomalous venation that is frequently found in the genus *Callipterus*. The drawing is taken from the wings of *Callipterus genevei.*

PLATE III.

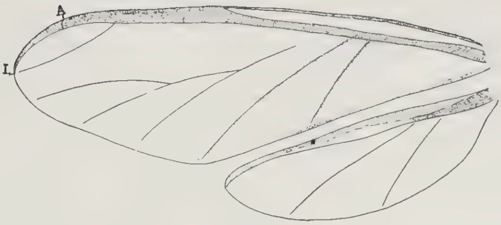

Fig. 18.

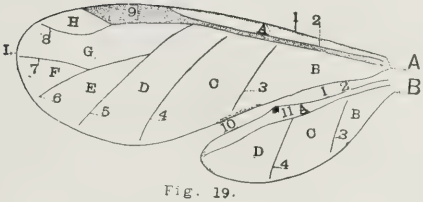
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Fig. 19.

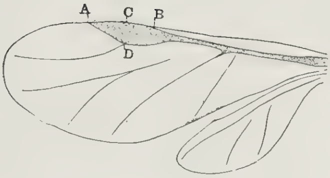


Fig. 20.

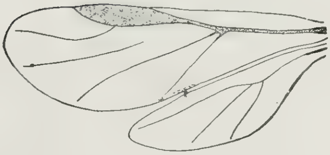


Fig. 21.

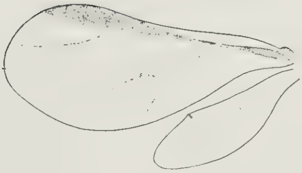


Fig. 22.

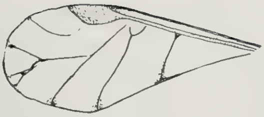


Fig. 23.

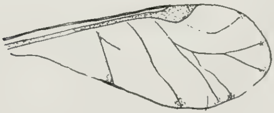


Fig. 24.

PLATE IV.

Fig. 25.
Fig. 26.
Fig. 27.—*Phylloxera caryæcaulis* Fitch.
Fig. 28.—*Pemphigus fraxinifolii* Riley.
Fig. 29.—*Pemphigus populitransverus* Riley.
Fig. 30.—*Pemphigus burrowi*, n. sp.
Fig. 31.—*Myzus prunifoliæ* Fitch.
Fig. 32.—*Callipterus*, n. sp.

PLATE IV.

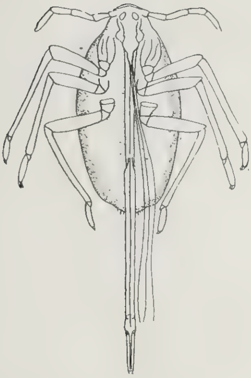


Fig. 25

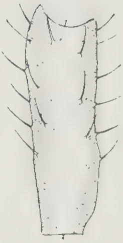


Fig. 25. a

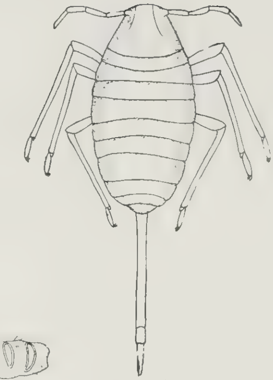


Fig 26.

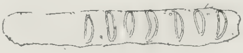


Fig 28,a.

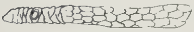


Fig 27. a.

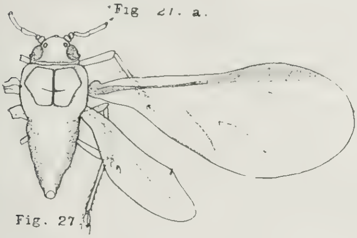


Fig. 27.

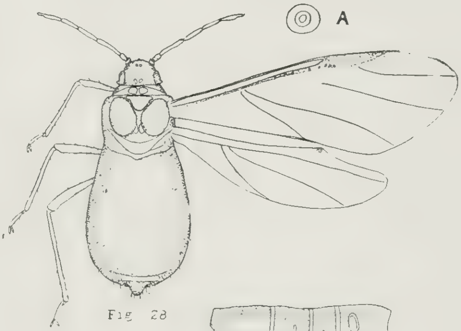


Fig 28

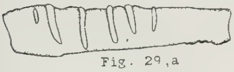


Fig. 29,a

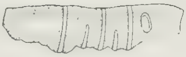


Fig. 30,a

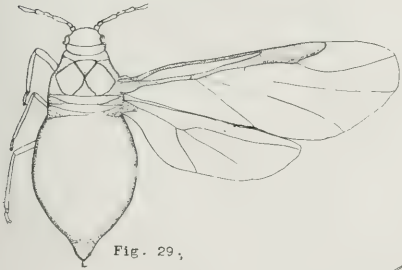


Fig. 29.

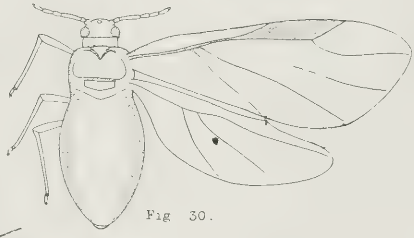


Fig 30.

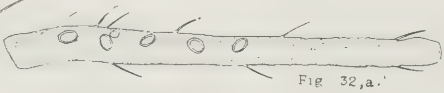


Fig 32,a.

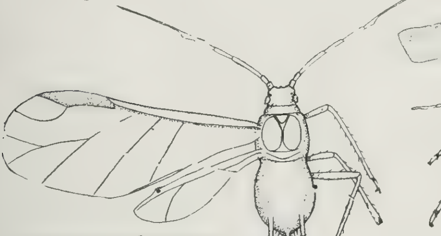


Fig 31.

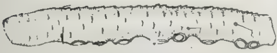


Fig. 31,a.

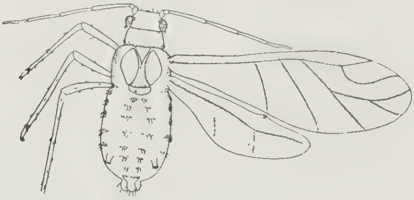


Fig. 32.

PLATE V.

Fig. 33.—*Pemphigus populicaulis* Fitch.
Fig. 34.—*Tetraneura ulmi* De G.
Fig. 35.—*Aphis* sp. ?
Fig. 36.—*Schizoneura lanigera* Hausm.

PLATE V.

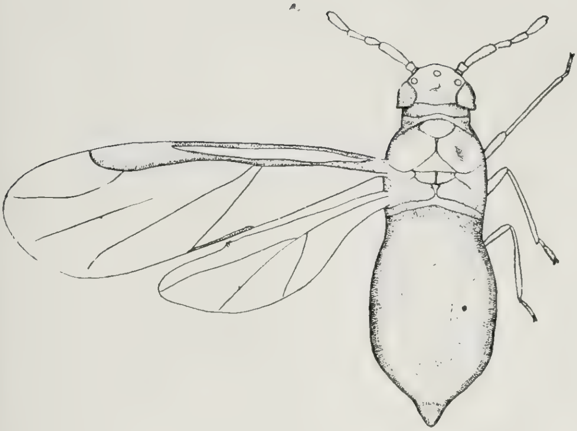


Fig. 33.

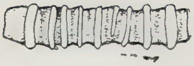


Fig 33,a.

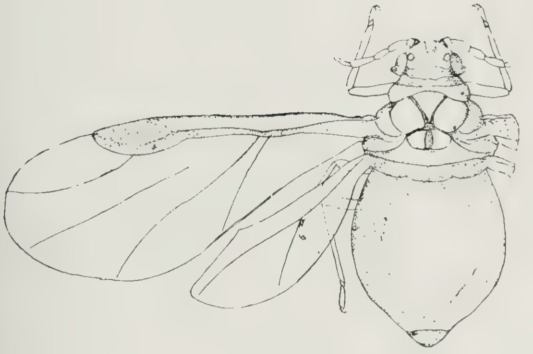


Fig. 34

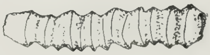


Fig 34,a

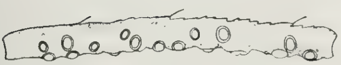


Fig. 35.a

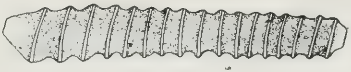
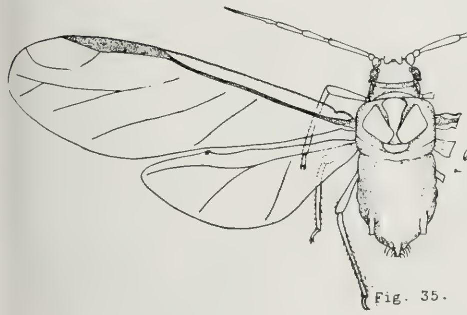


Fig 36,a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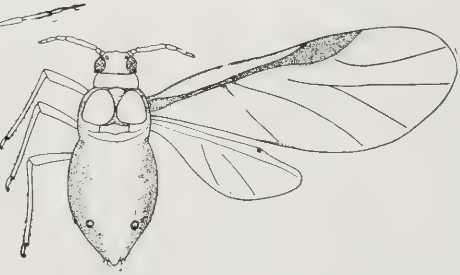


Fig. 36.

PLATE VI.

Fig. 37.—*Schizoneura americana* Riley.
Fig. 38.—*Schizoneura corni* Fab.
Fig. 39.—*Lachnus longistigma* Monell.
Fig. 40 —*Pemphigus populicaulis* Fitch. Apterous form.
Fig. 41.—*Schizoneura* sp.

PLATE VI.

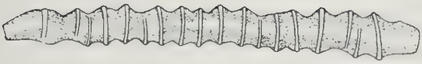
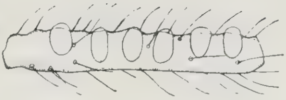


Fig. 37,a



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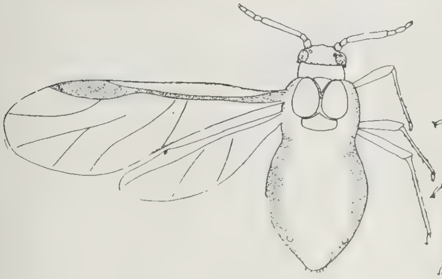


Fig 37.

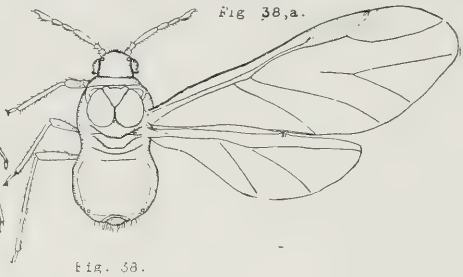
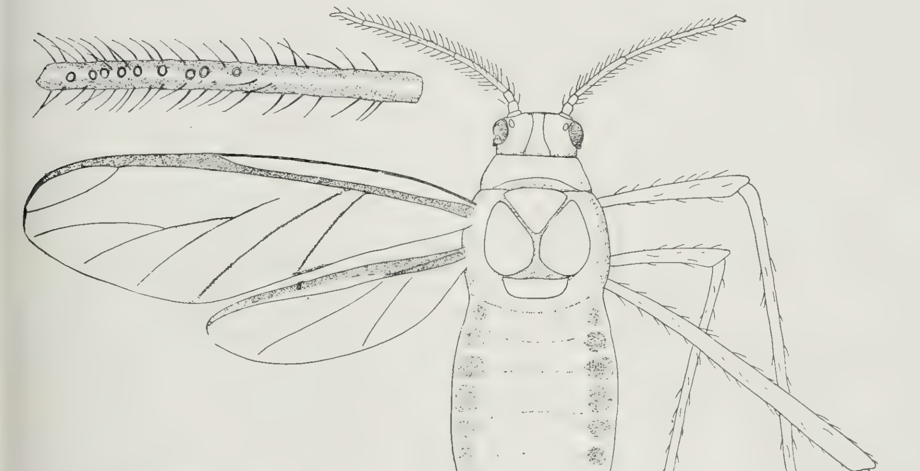


Fig. 38.



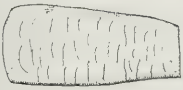
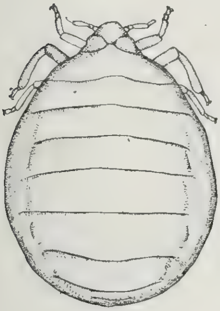


Fig. 40, a

Fig. 39



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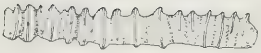


Fig 41, a.

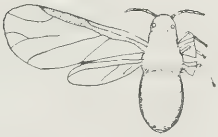
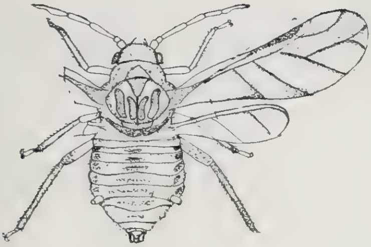


Fig. 41

PLATE VII.

Fig. 42.—*Chaitophorus populicola* Fitch.
Fig. 43.—*Chaitophorus.*
Fig. 44.—*Callipterus bellus* Walsh.
Fig. 45.—*Callipterus genevei*, n. sp.
Fig. 46.—*Callipterus.* (See despription of figure 32.)
Fig. 47.—*Chaitophorus stevensis*, n. sp.

PLATE VII.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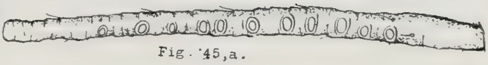
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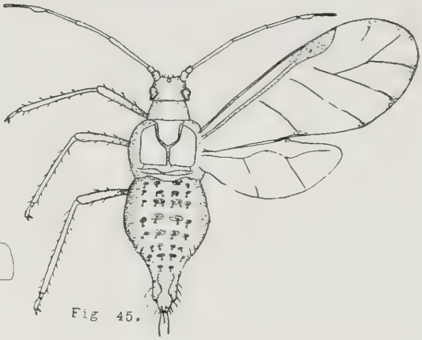


Fig 45.

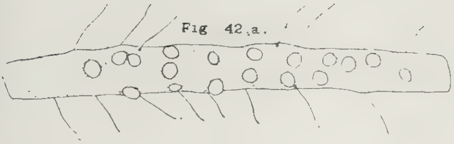


Fig 42,a.

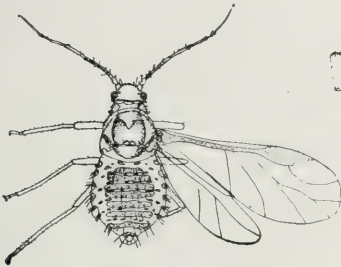


Fig. 43.

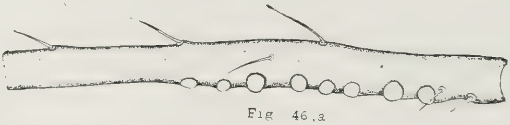


Fig 46,a

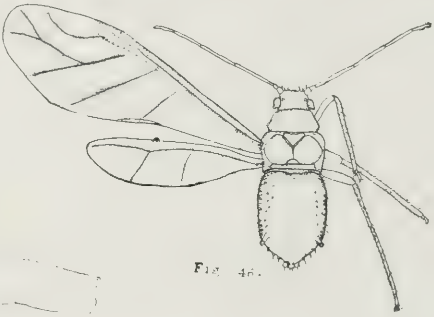
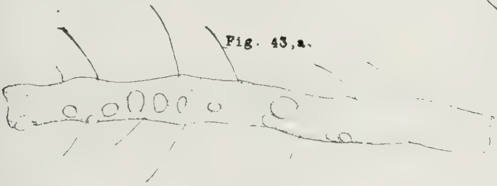


Fig 46.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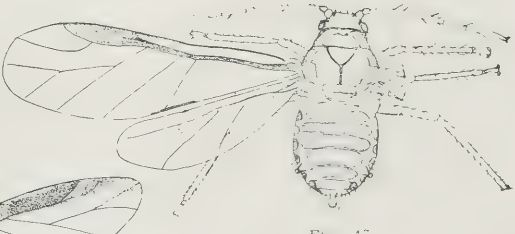


Fig 47.

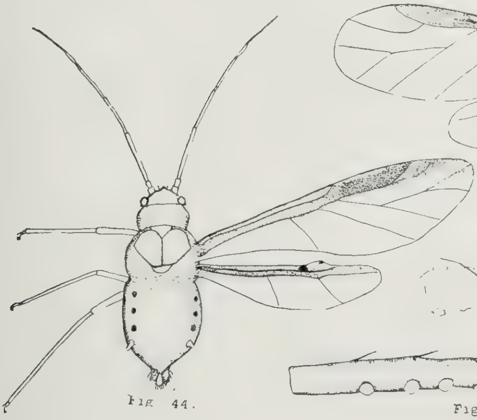


Fig 44.

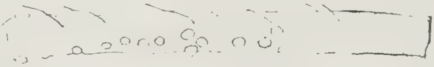


Fig 47,a

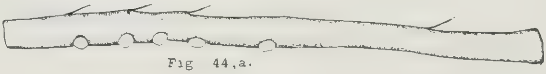


Fig 44,a.

PLATE VIII.

Fig. 48.—*Aphis nerii* **Fonsc.**
Fig. 49.—*Siphocoryne avenæ* **Fabr.**
Fig. 50.—*Sipha rubifolii* **Thomas.**

PLATE VIII.

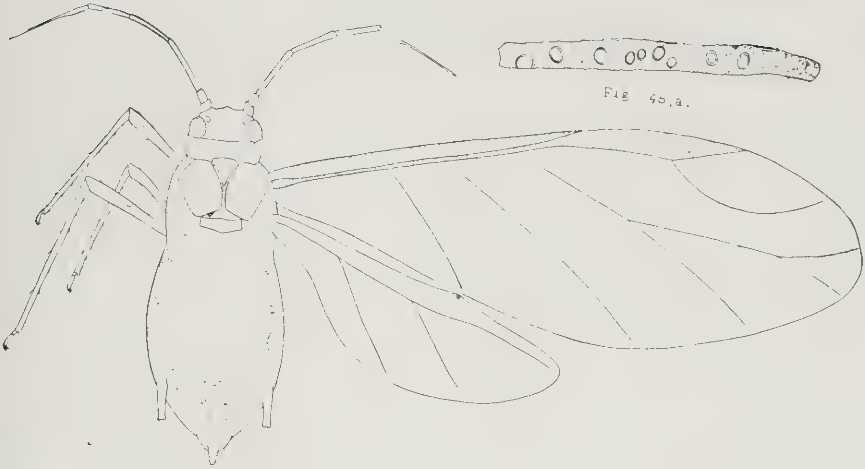


Fig. 48,a.

Fig. 48

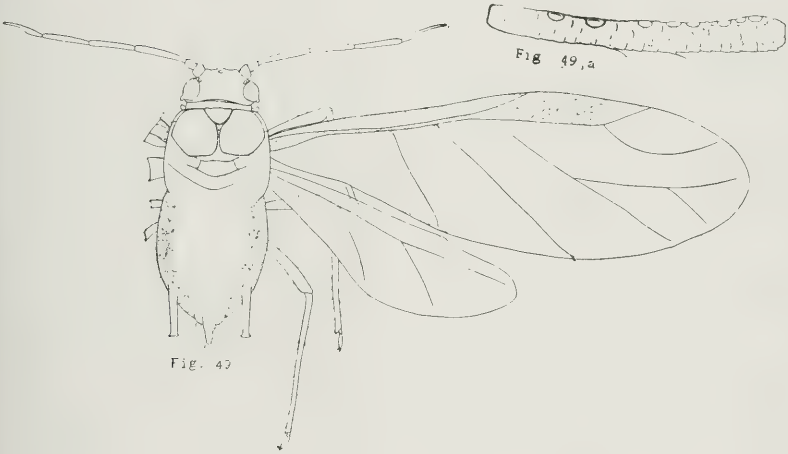


Fig 49,a

Fig. 49

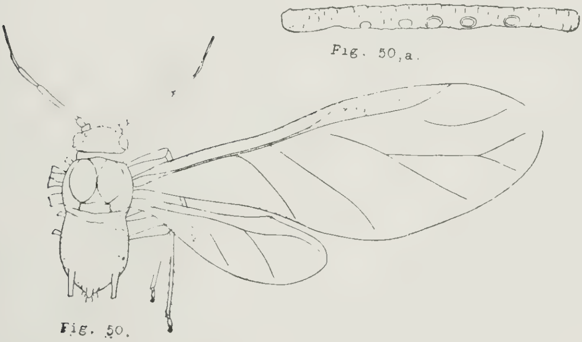


Fig. 50,a.

Fig. 50.

PLATE IX.

Fig. 51.—*Myzus biennis*, n. sp.
Fig. 52.—*Aphis* sp. ?
Fig. 53.—*Myzus achyrantes* Monell.
Fig. 54.—*Myzus cerasi* Fab.
Fig. 55.—*Rhopalosiphum dianthi* Schrank.
Fig. 56.—*Callipterus asclepiadis* Monell.

PLATE IX.

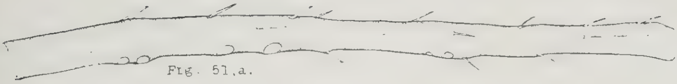


Fig. 51,a.

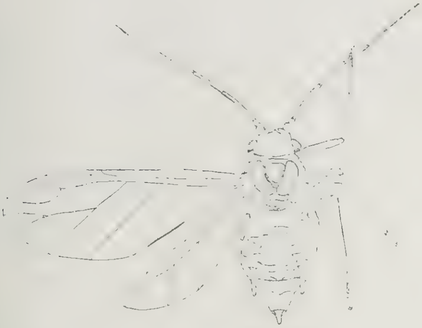


Fig. 51.

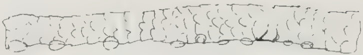


Fig. 54,a.

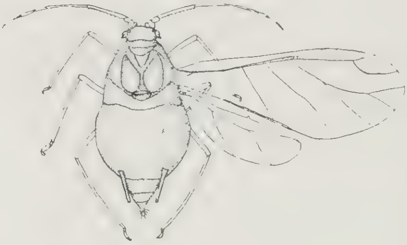


Fig. 54.

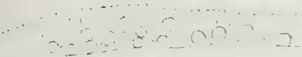


Fig. 52,a

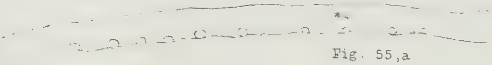


Fig. 55,a

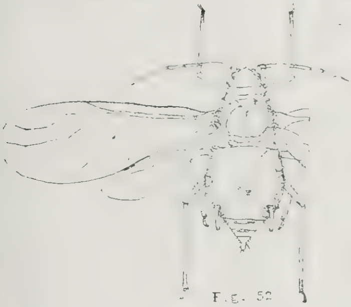


Fig. 52

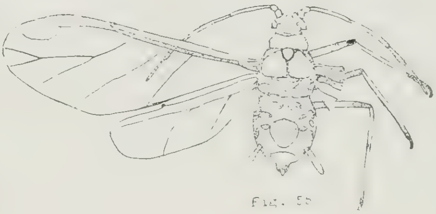


Fig. 55

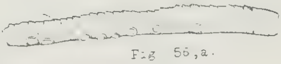


Fig. 56,a.

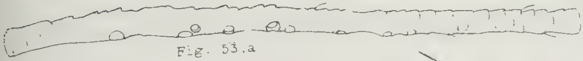


Fig. 53.a

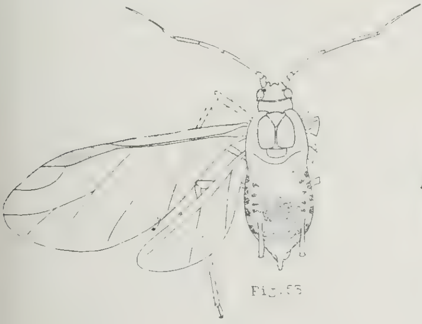


Fig. 53

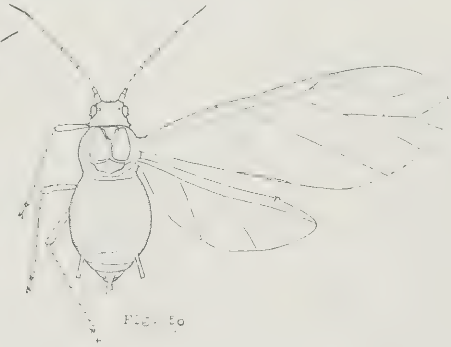


Fig. 56

PLATE X.

Fig. 57.—*Aphis* sp. ?
Fig. 58.—*Chaitophorus negundinis* Thomas.
Fig. 59.—*Aphis cerasifoliæ* Fitch.
Fig. 60.—*Aphis sambuci* Linn.
Fig. 61.—*Aphis brossicæ* Linn.

PLATE X.

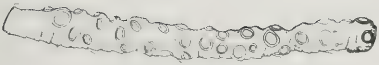


Fig. 57 A

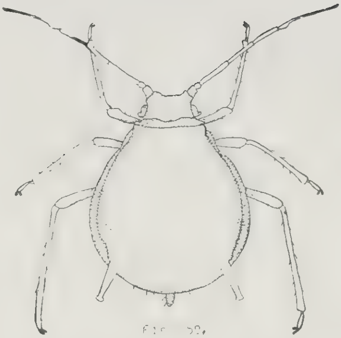


Fig. 59.

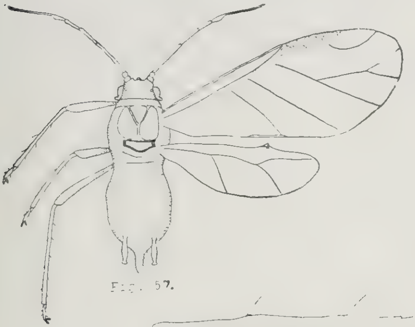


Fig. 57.

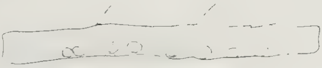


Fig. 58,a.

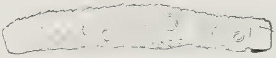


Fig. 60,a.

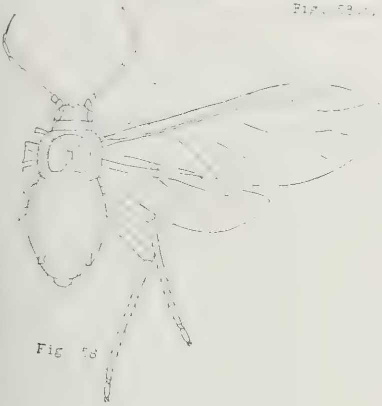


Fig 58

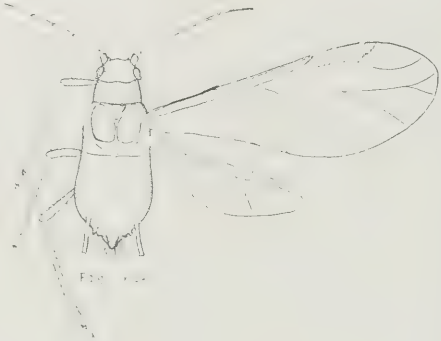


Fig. 60.

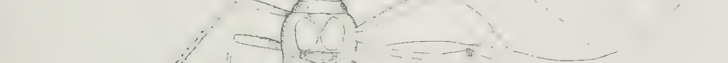


Fig 61,a

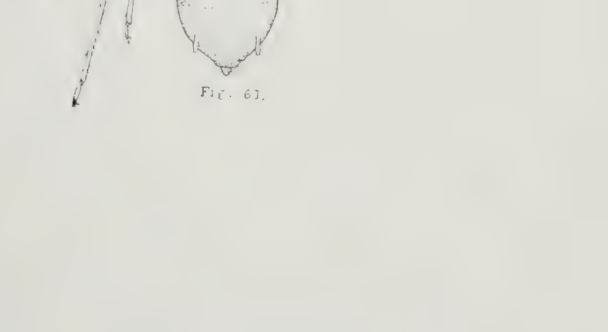
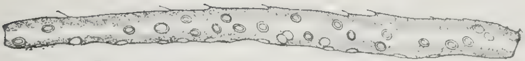


Fig. 61.

PLATE XI.

Fig. 62.—*Aphis* sp. ?
Fig. 63.—(Description lost.)
Fig. 64.—*Aphis gossypii* Glover.
Fig. 65.—*Aphis vitis* Scop.
Fig. 66.—*Aphis maidis* Fitch.
Fig. 67.—*Aphis rumicis* Linn.

PLATE XI.



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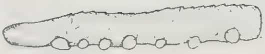


Fig. 65,a.

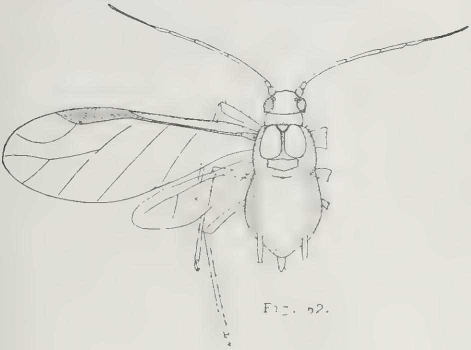
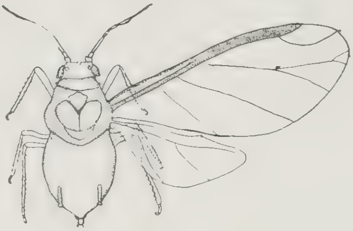


Fig. 62.



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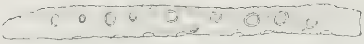


Fig. 66,a.

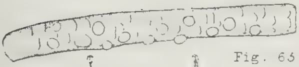


Fig. 63,a.

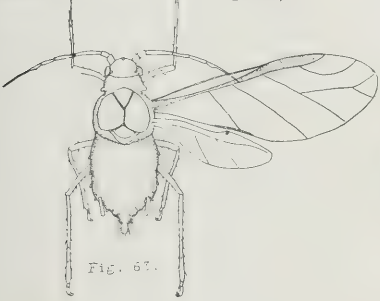


Fig. 63.

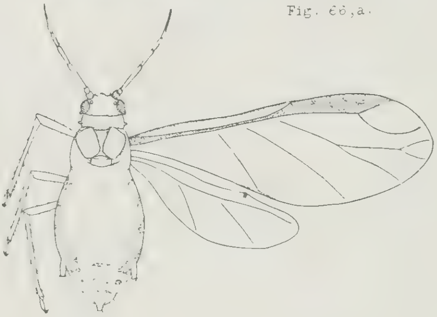


Fig. 66.

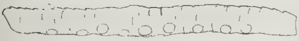


Fig. 64,a

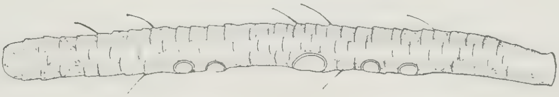


Fig. 67,a.

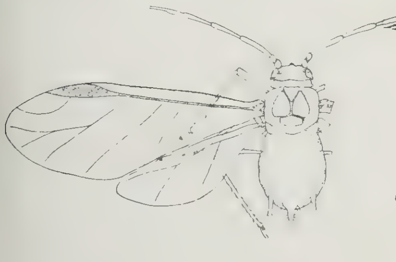


Fig. 64.

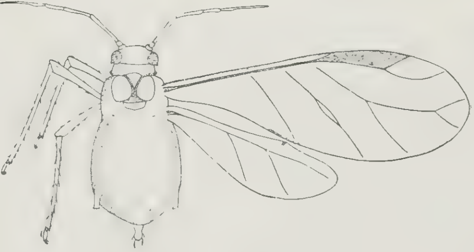
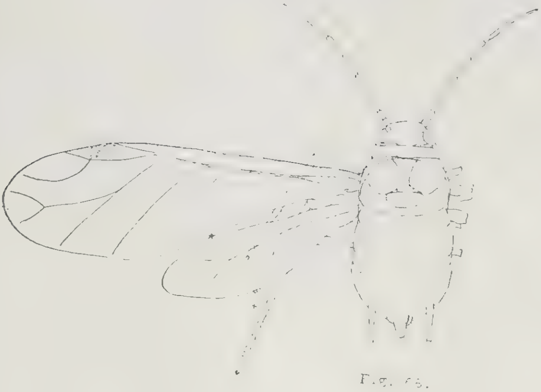


Fig. 67.

PLATE XII.

Fig. 68.—(Description lost.)
Fig. 69.—*Aphis gossypii* Glover.
Fig. 70.—*Macrosiphum.*
Fig. 71.—*Aphis* sp.?

PLATE XII.



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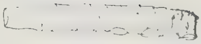


Fig. 68,a.

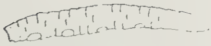


Fig 69,a

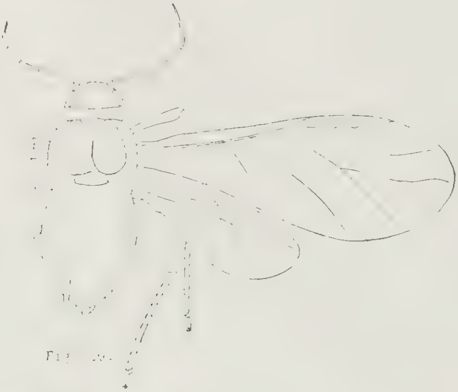


Fig. 69.

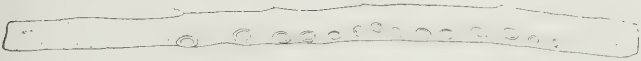
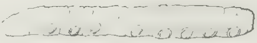


Fig. 70,a.



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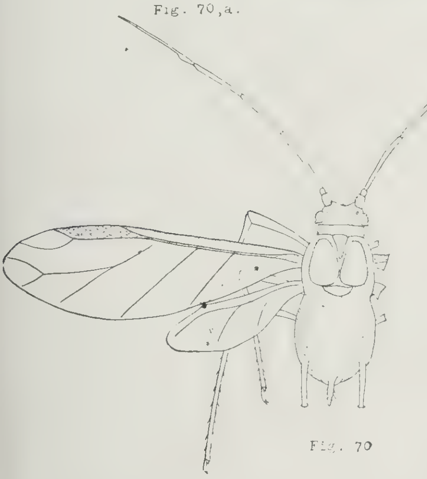


Fig. 70

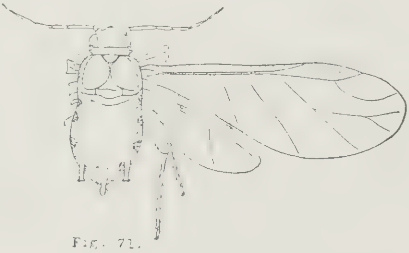


Fig. 71.

PLATE XIII.

Fig. 72.—*Aphis nerii.* (See description to figure 48.)
Fig. 73.—*Rhopalosiphum rois* Monell.
Fig. 74.—*Aphis cratægifolia* Fitch.

PLATE XIII.

Fig 72,a

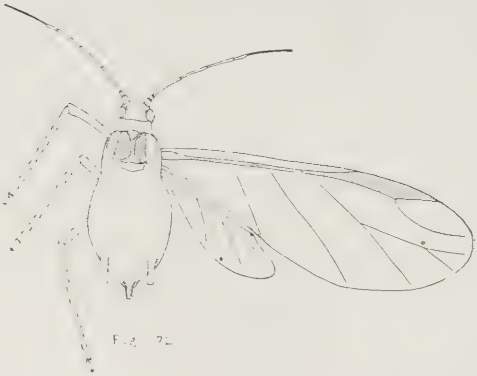


Fig. 72

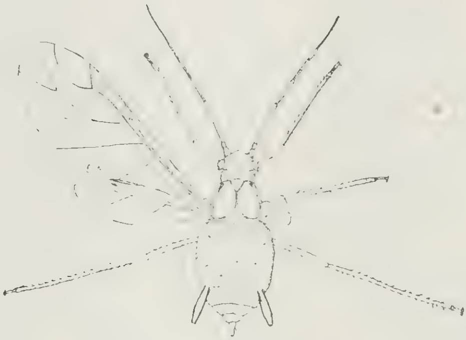
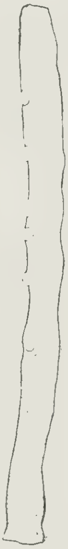


Fig 73



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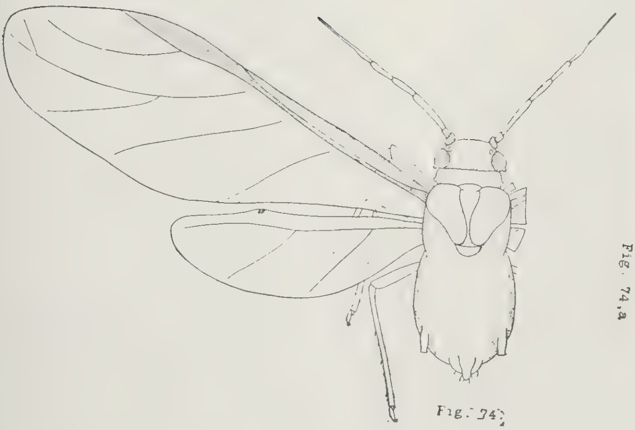


Fig. 74

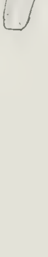
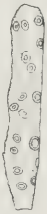


Fig. 74,a

PLATE XIV.

Fig. 75.—*Aphis*, n. sp.
Fig. 76.—*Callipterus*, n. sp.
Fig. 77.—*Aphis*, n. sp.

PLATE XIV.



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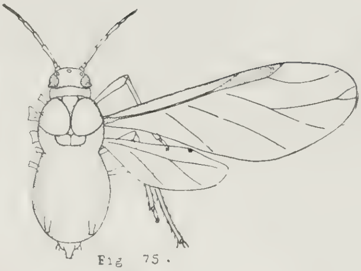

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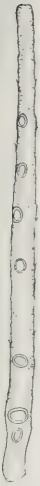

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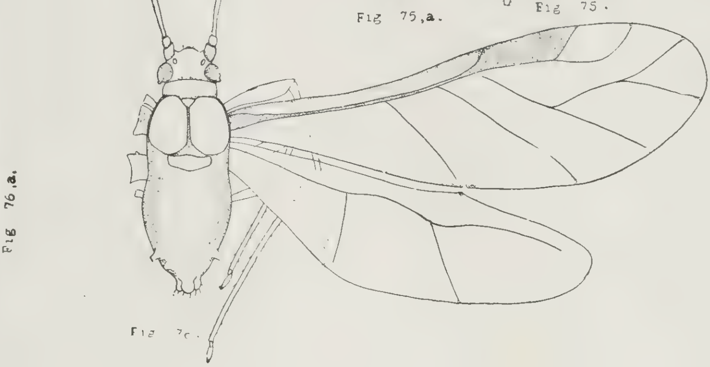

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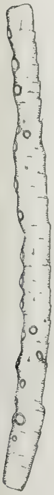


Fig 77,a.

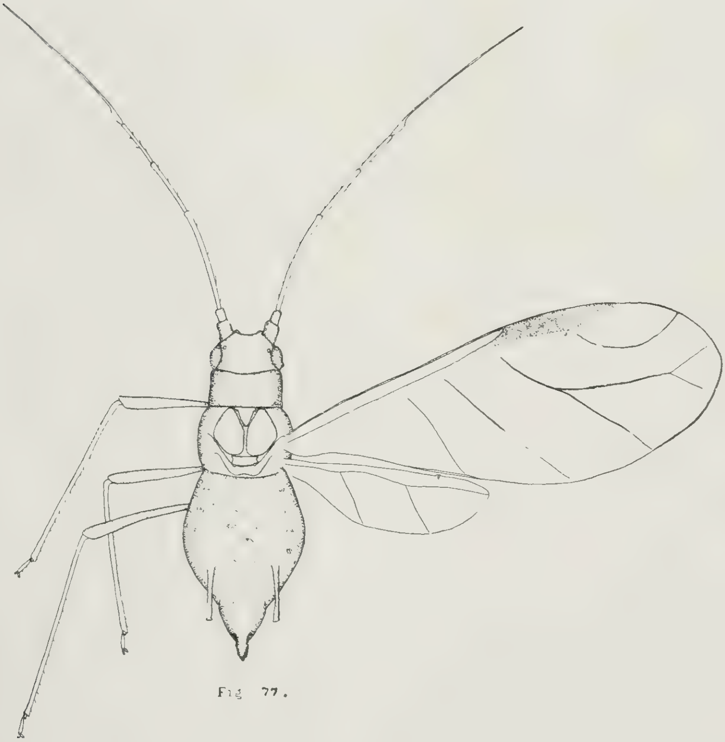


Fig 77.

PLATE XV.

Fig. 78.—*Rhopalosiphum violæ* Pergande.
Fig. 79.—*Macrosiphum*, n. sp.
Fig. 80.—*Macrosiphum pisi* Kalt.

PLATE XV.

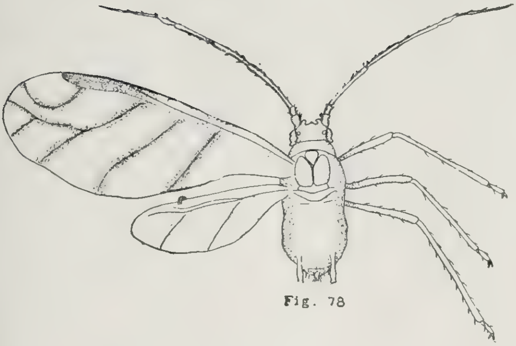


Fig. 78

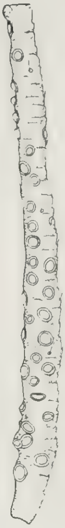
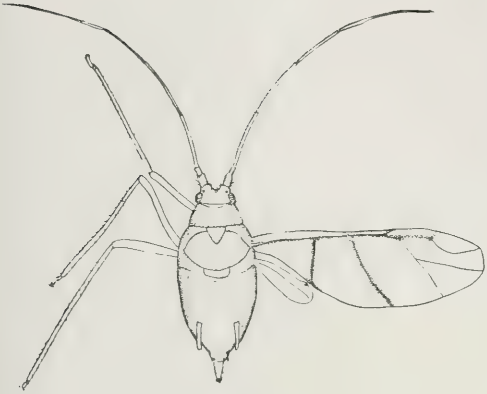


Fig. 78,a.



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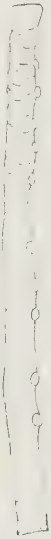


Fig. 79,a.

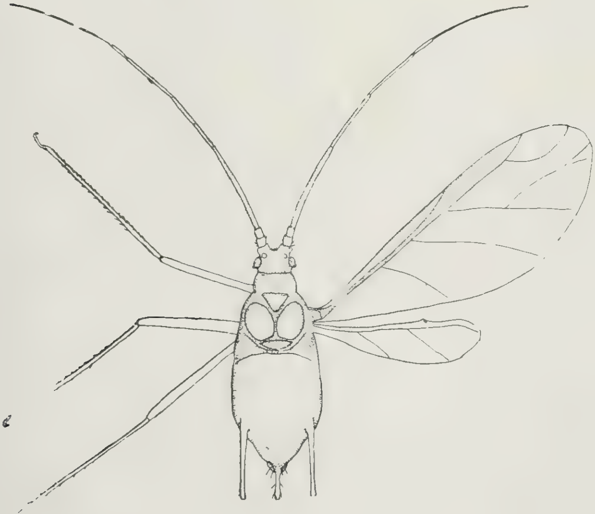


Fig. 80.

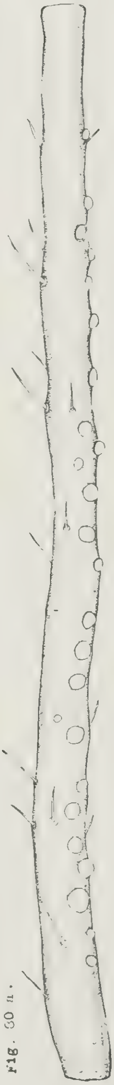


Fig. 80 a.

PLATE XVI.

Fig. 81.—*Myzus persicæ* Sulz.
Fig. 82.—*Aphis ribis*, n. sp.
Fig. 83.—*Aphis cardui* Linn.
Fig. 84.—*Macrosiphum squarrosa*, n. sp.

PLATE XVI.

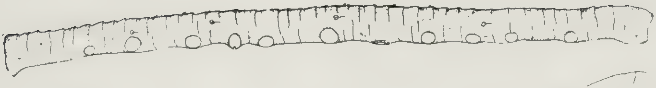


Fig. 81,a

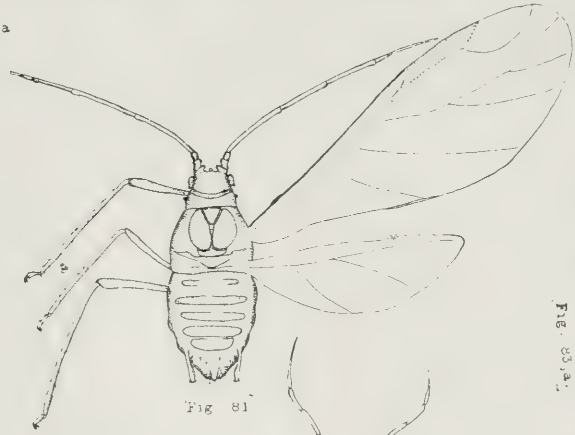


Fig 81

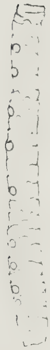


Fig 82,a.

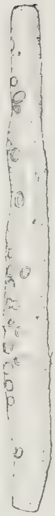


Fig. 83,a.

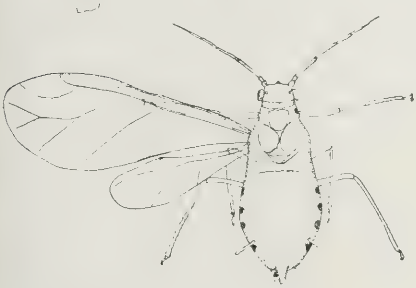


Fig 82.

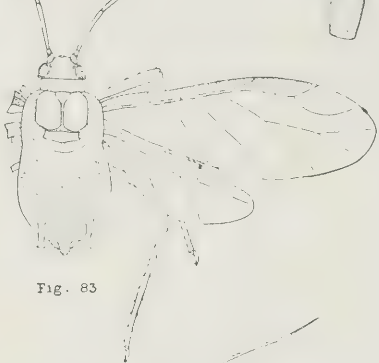


Fig. 83

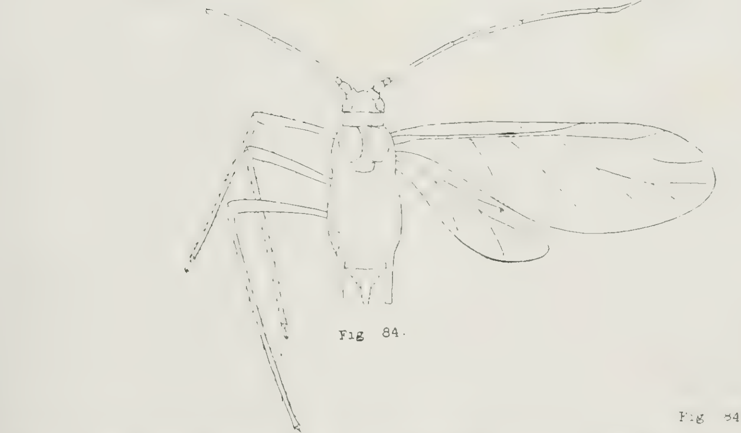


Fig 84.

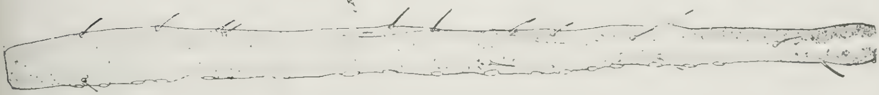
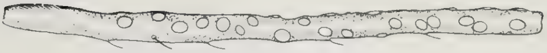


Fig 84,a

PLATE XVII.

Fig. 85.—*Macrosiphum chrysanthemi* Oestl.
Fig. 86.—*Macrosiphum* sp. ?

PLATE XVII.



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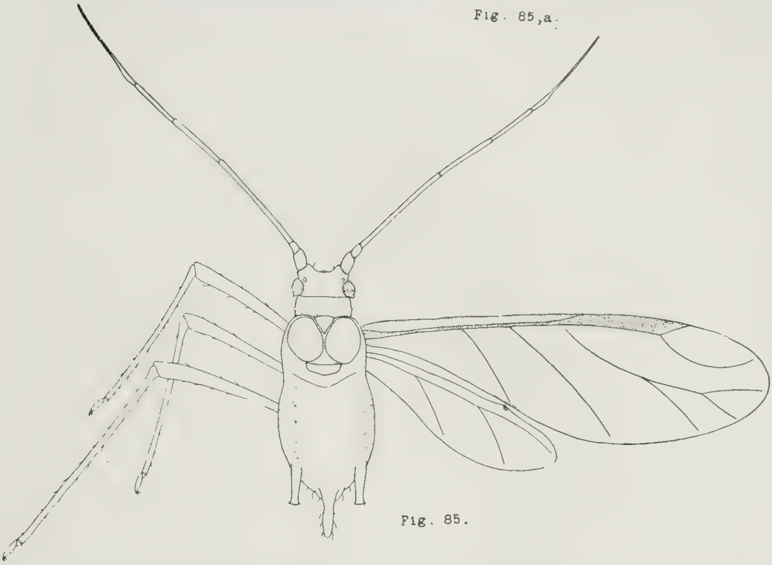


Fig. 85.

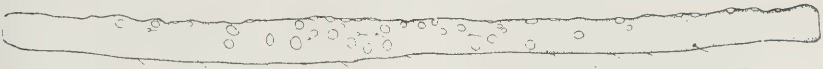


Fig 86,a

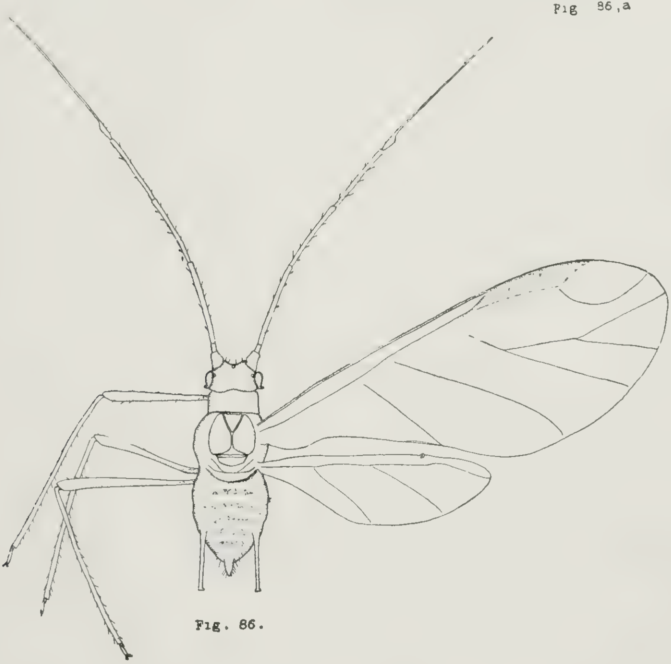


Fig. 86.

PLATE XVIII.

Fig. 87.—*Macrosiphum ambrosiæ* Thomas.
Fig. 89.—*Macrosiphum* sp. ?

PLATE XVIII.

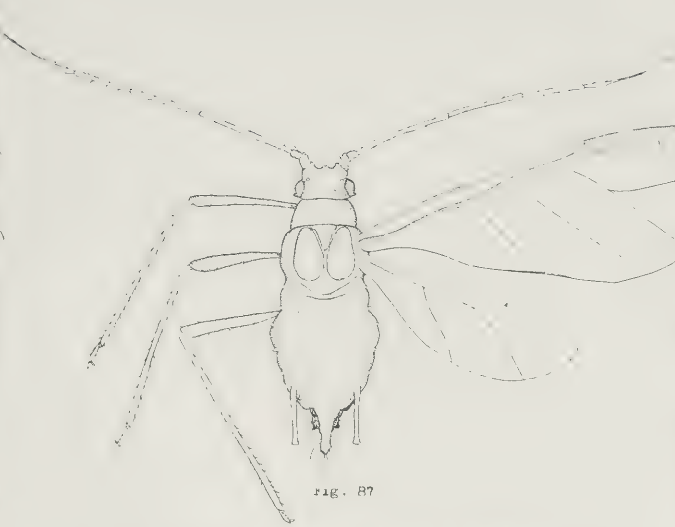
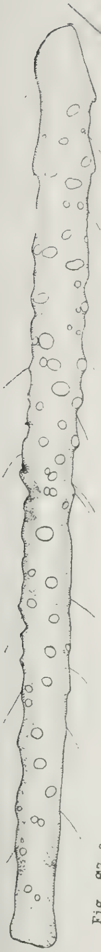


Fig. 87



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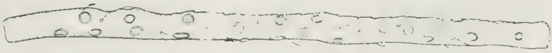

Fig. 88,a.

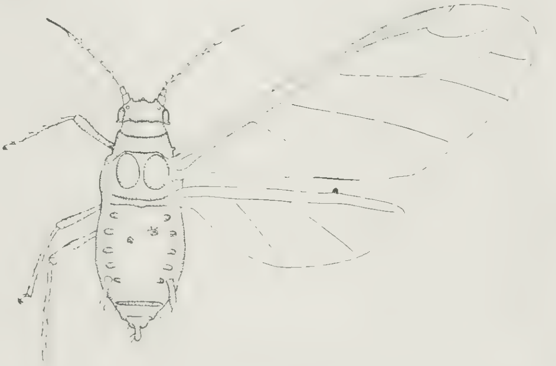

Fig. 88.

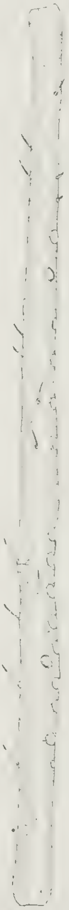

Fig. 89a

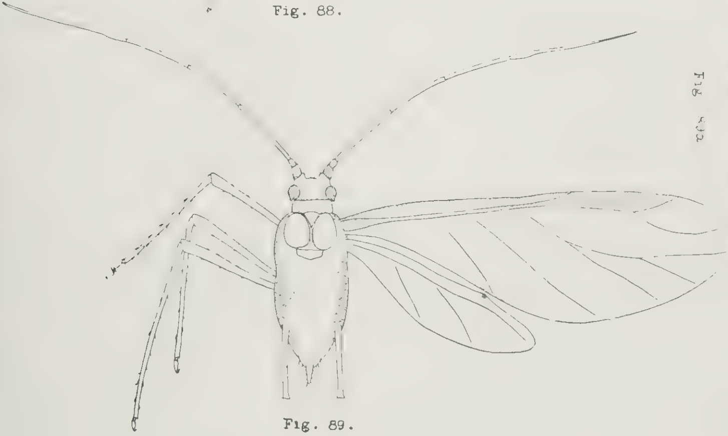

Fig. 89.

PLATE XIX.

Fig. 90.—*Macrosiphum* sp. ?
Fig. 91.—*Aphis sambucifolia* Fitch.
Fig. 92.—*Macrosiphum erigeronensis* Thomas.

PLATE XIX.

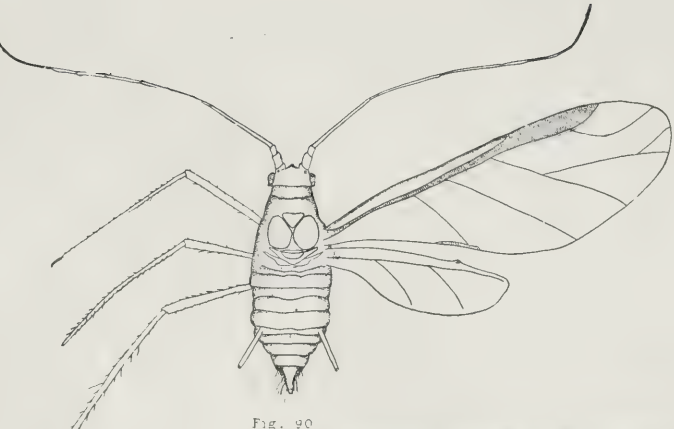

Fig. 90

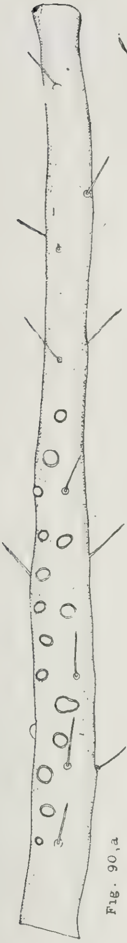

Fig. 90,a

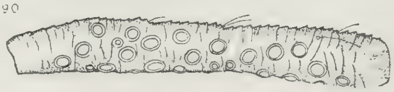

Fig 91,a

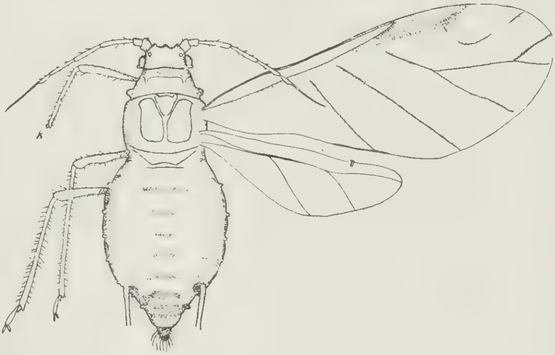

Fig. 91

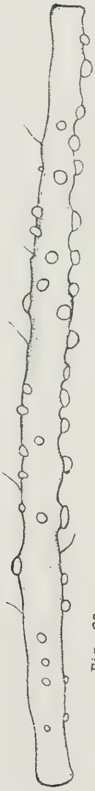

Fig. 92,a.

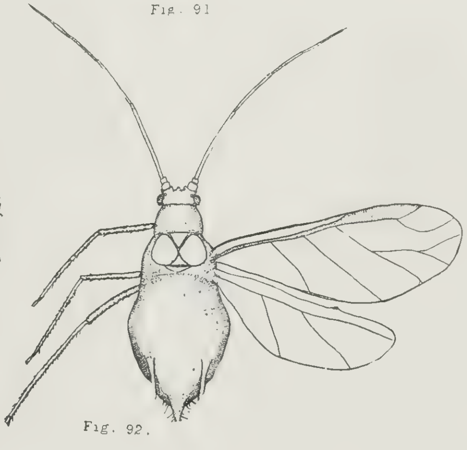

Fig. 92.

PLATE XX.

Fig. 93.—*Macrosiphum*, n. sp.
Fig. 94.—*Drepanosiphum acerifolii* Thomas.
Fig. 95.—*Chaitophorus flabellus*, n. sp.
Fig. 96.—*Phorodon*, n. sp.

PLATE XX.

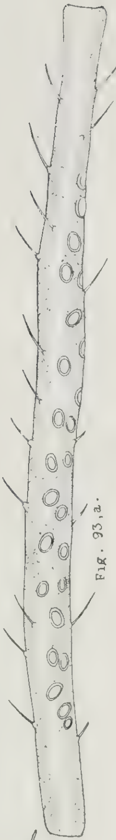

Fig. 93.a.

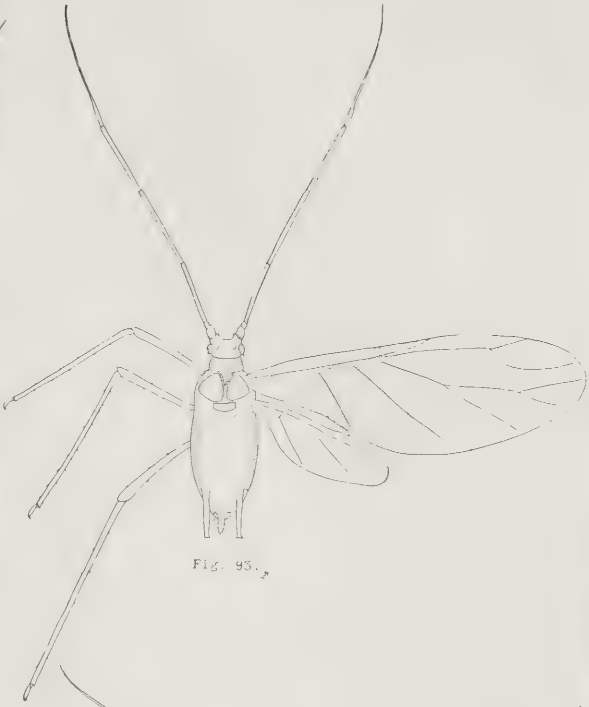

Fig. 93. ♂

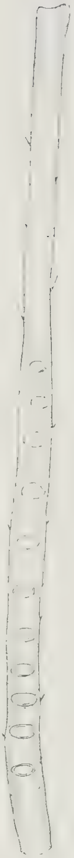

Fig. 94.a

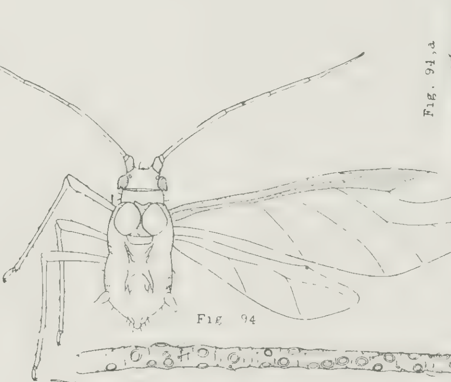

Fig. 94

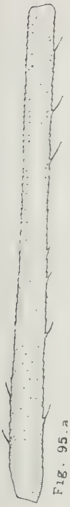

Fig. 95.a

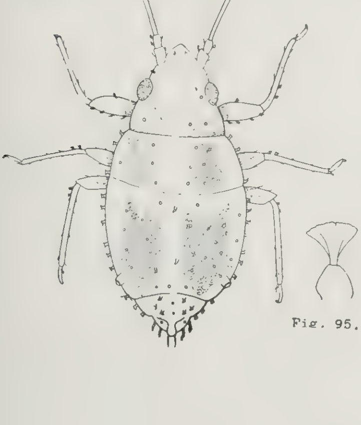

Fig. 95. b

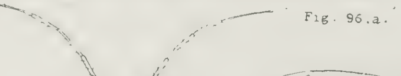

Fig. 96.a.

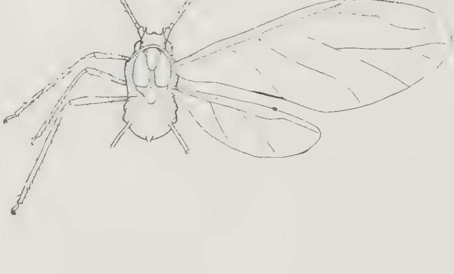

PLATE XXI.

Fig. 97.—*Macrosiphum*, n. sp.
Fig. 98.—*Macrosiphum* sp.

PLATE XXI.

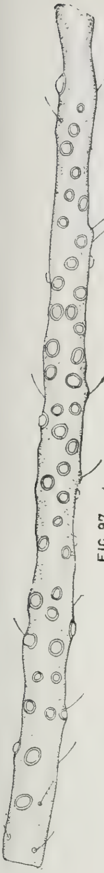

FIG 97, A

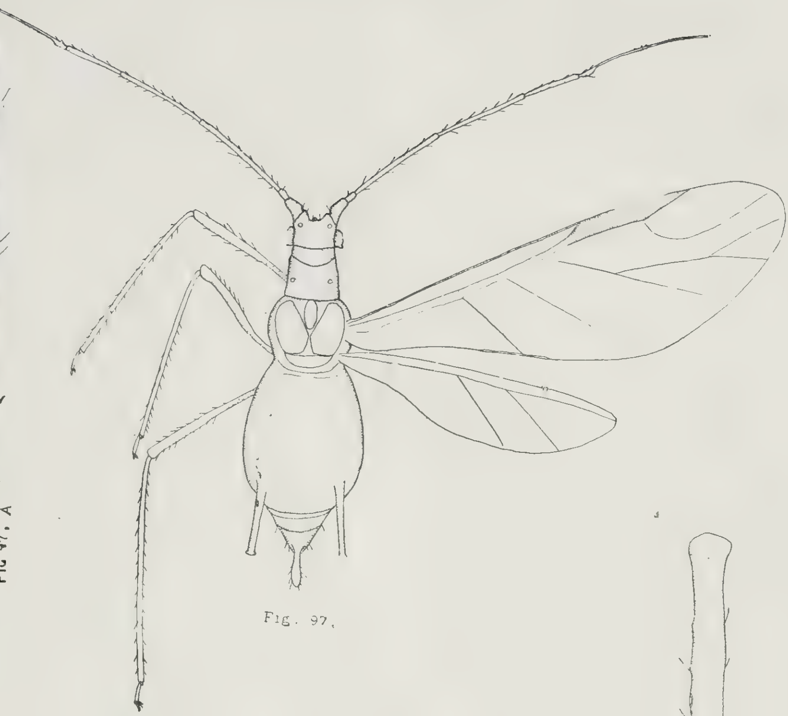

Fig. 97.

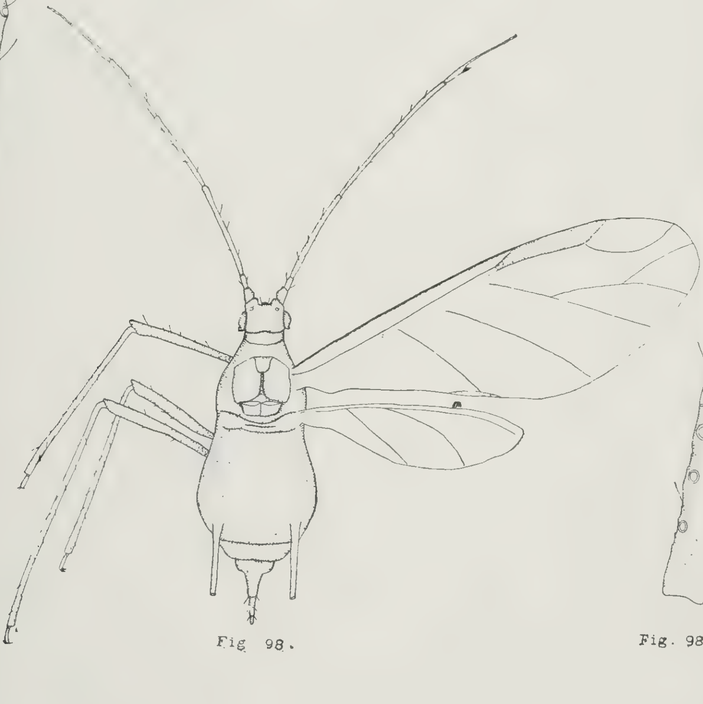

Fig 98.

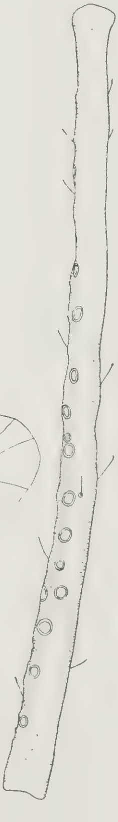

Fig. 98, a.

PLATE XXII.

Fig. 99.—*Macrosiphum ambrosiæ* Thomas.
Fig. 100.—*Aphis veronia*, n. sp.
Fig. 101.—*Phylloxera caryæcaulis* Fitch. (Stem-mother.)

PLATE XXII.

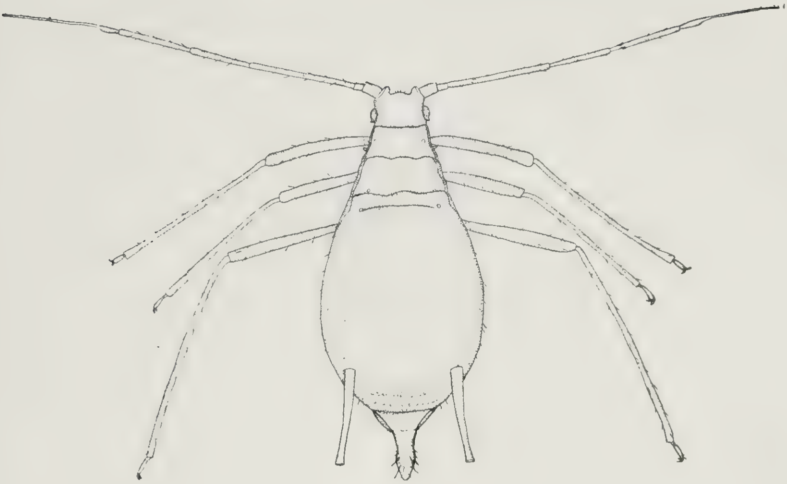

Fig. 99

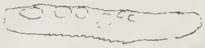

Fig 100,a

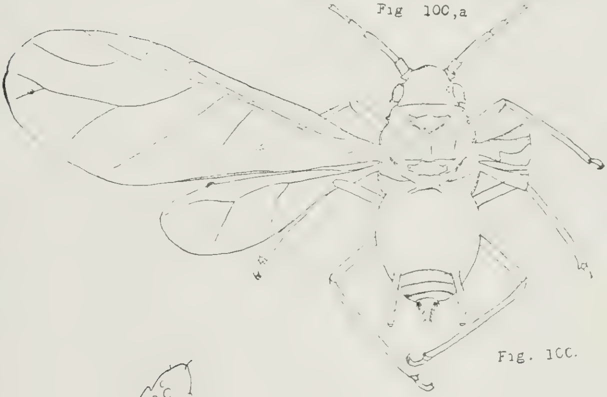

Fig. 100.

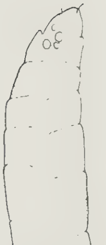

Fig. 101.

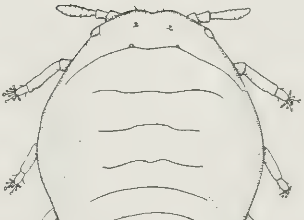

Fig. 101.

PLATE XXIII.

FIGS. 1 and 2. *Parlatoria zizyphus* Lucas, showing the more regular arrangement of the dorsal glands. Drawn with 4 ocular and $\frac{1}{6}$ objective.

a.—anal orifice.
b.—chitinized disk.
c.—dorsal-gland.
d.—marginal gland.
e.—median dorsal gland.
f.—dorsal gland orifice.
g.—marginal-gland orifice.
h.—pair of glands between anal orifice and the third lobe.
i.—first lobe.
j.—second lobe.
k.—third lobe.
l.—fourth lobe.
n.—plate.
o.—spine.
p.—spinnerets, circumgenital, grouped or ventral glands.
q.—anterior group of circumgenital glands.
r.—posterior group of circumgenital glands.

PLATE XXIII.

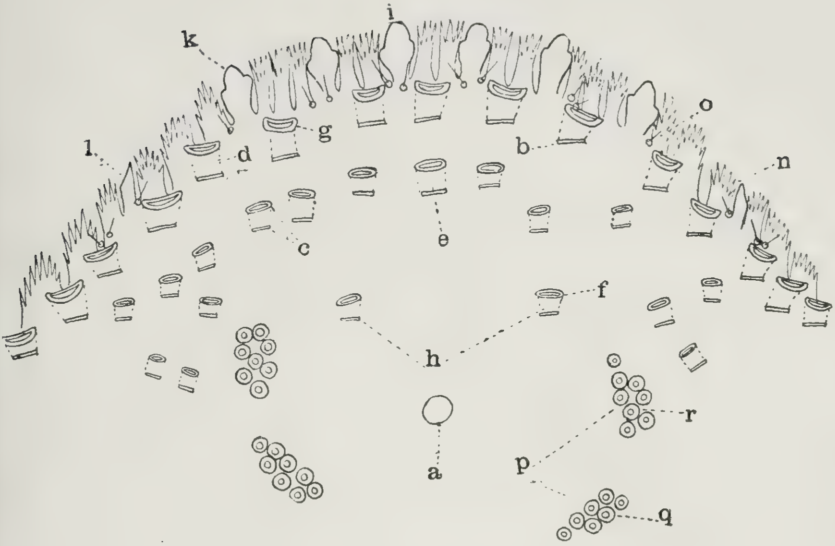
i
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Fig. 1.

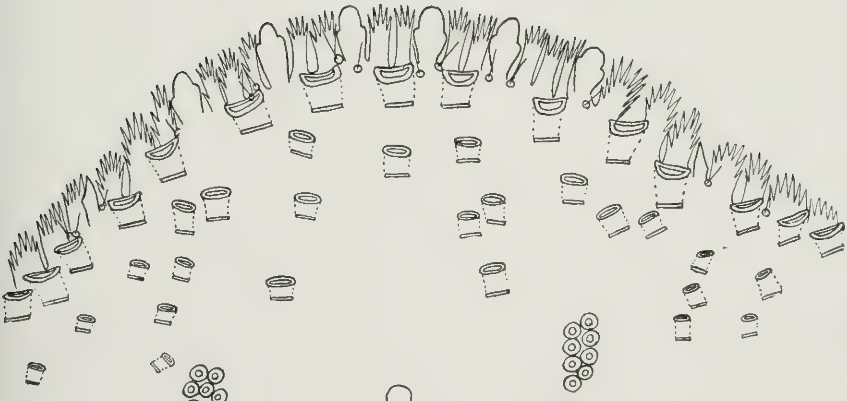


Fig. 2.

PLATE XXIV.

Fig. 1. *Parlatoria aonidiformis* Green. The circumgenital glands are not shown because the specimens studied were not well enough cleared to show the glands satisfactorily and no other specimens were available. Drawn with 4 ocular and ¼ objective.

Fig. 2. *Parlatoria blanchardi* Targ. Drawn with 4 ocular and ⅙ objective.

Fig. 3. *Parlatoria victrix* Ckll. Drawn with 4 ocular and ¼ objective.

PLATE XXIV.

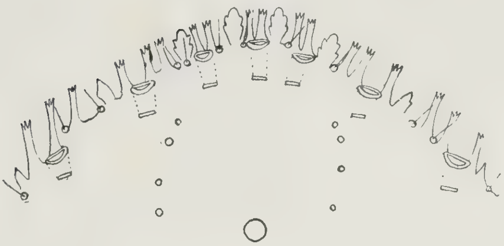
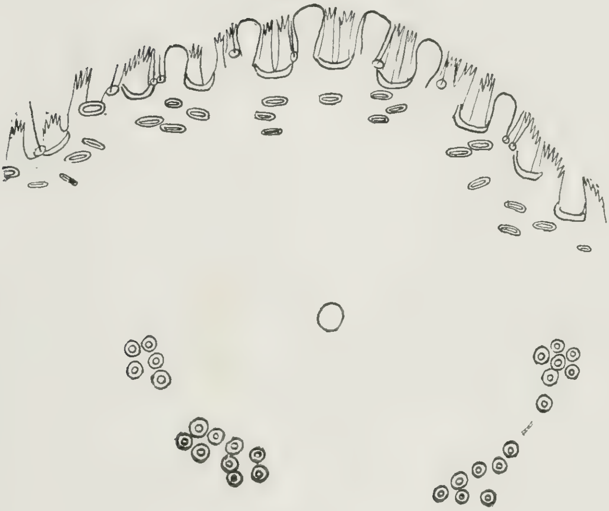


Fig. 1



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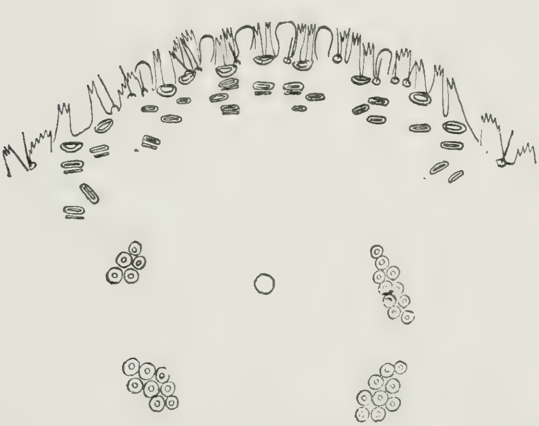


Fig. 3.

PLATE XXV.

Fig. 1.—*Parlatoria proteus* Curt. Drawn with 4 ocular and $\frac{1}{6}$ objective.

Fig 2.—*Parlatoria proteus pergandei* Comst. Drawn with 4 ocular and $\frac{1}{4}$ objective.

PLATE XXV.

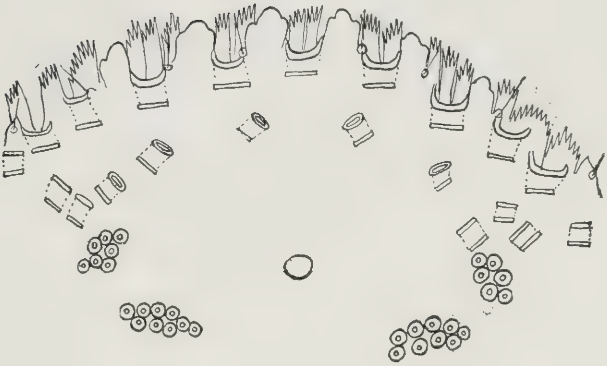


Fig. 1

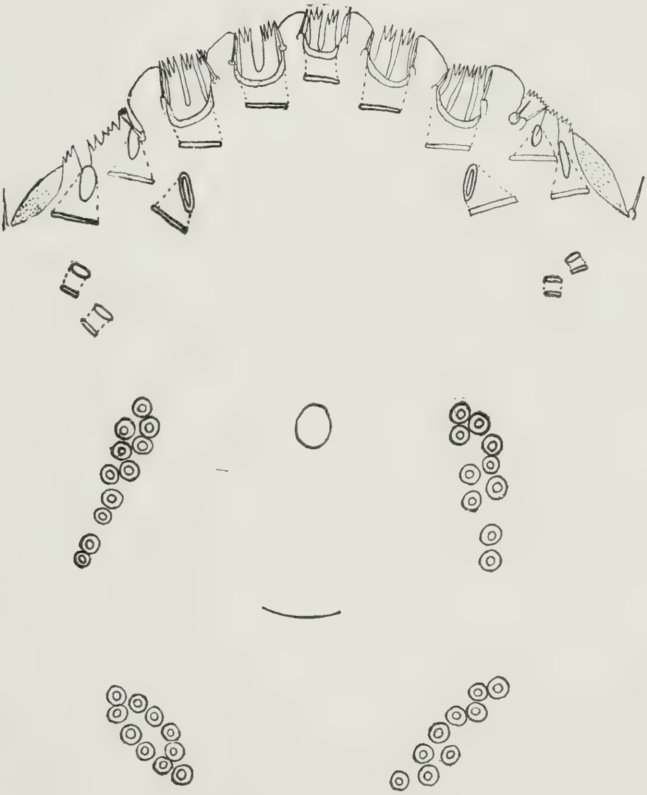


Fig. 2.

PLATE XXVI.

Fig. 1.—*Parlatoria mytilaspiformis* Green. Drawn with 4 ocular and $\frac{1}{4}$ objective.

Fig. 2.—*Parlatoria mytilaspiformis* Green. Drawn with 4 ocular and $\frac{1}{6}$ objective.

PLATE XXVI.

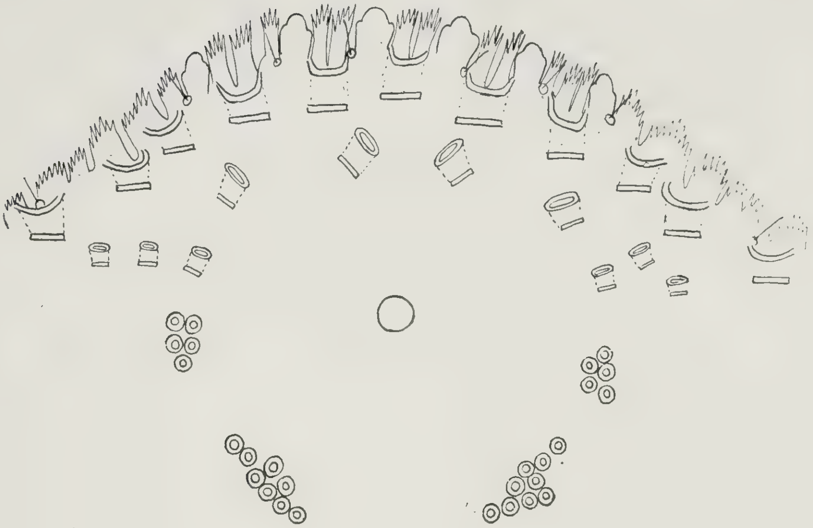


Fig. 1.

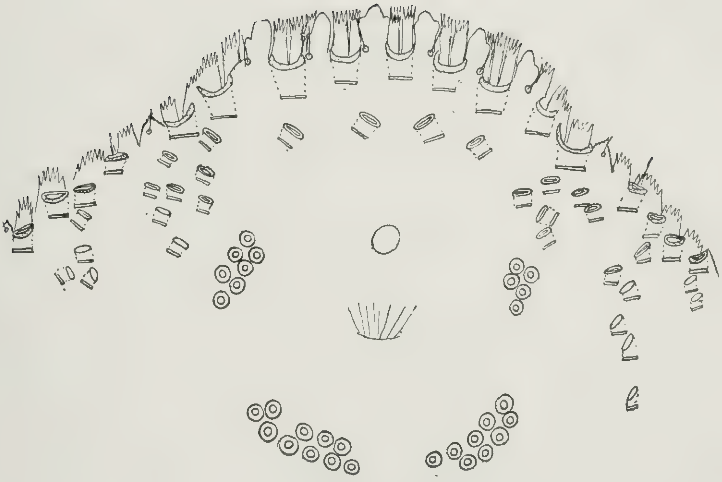


Fig. 2.

PLATE XXVII.

Fig. 1.—*Parlatoria theæ* Ckll. **Drawn with 4 ocular and ¼ objective.**

Fig 2.—*Parlatoria theæ euonymi* Ckll. **Drawn with 4 ocular and ¼ objective.**

Fig. 3.—*Parlatoria theæ viridis* Ckll. **Drawn with 4 ocular and ¼ objective.**

PLATE XXVII.

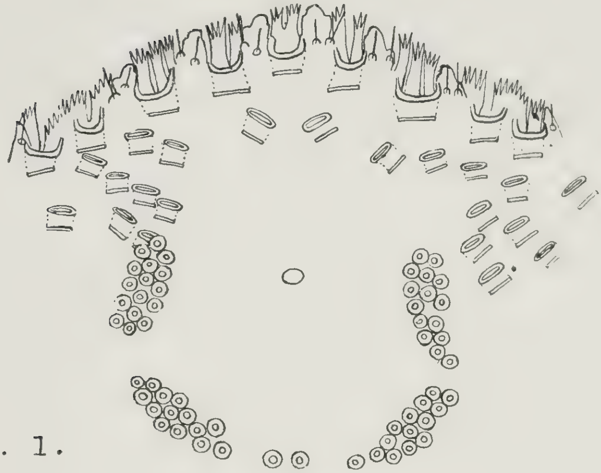


Fig. 1.

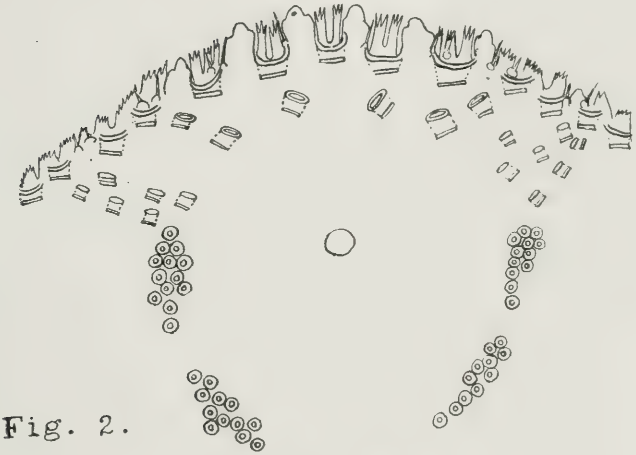


Fig. 2.

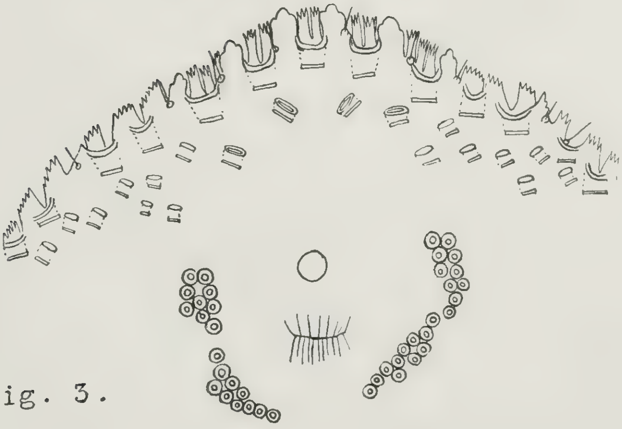


Fig. 3.

PLATE XXVIII.

Fig. 1.—*Parlatoria proteus crotonis* Ckll. Drawn with 4 ocular and $\frac{1}{4}$ objective.

Fig. 2.—*Parlatoria cingala* Green. Drawn with 4 ocular and $\frac{1}{6}$ objective.

PLATE XXVIII.

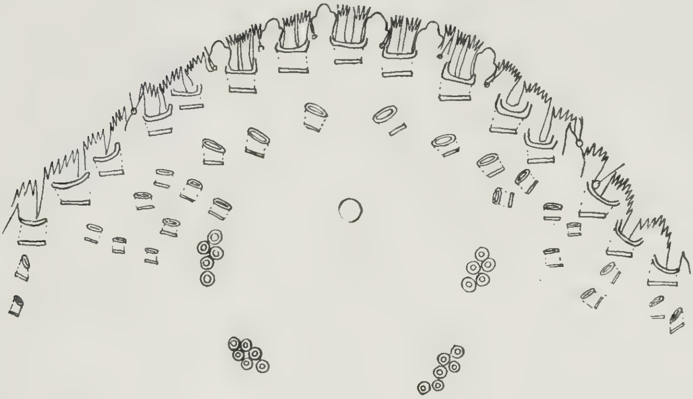


Fig. 1

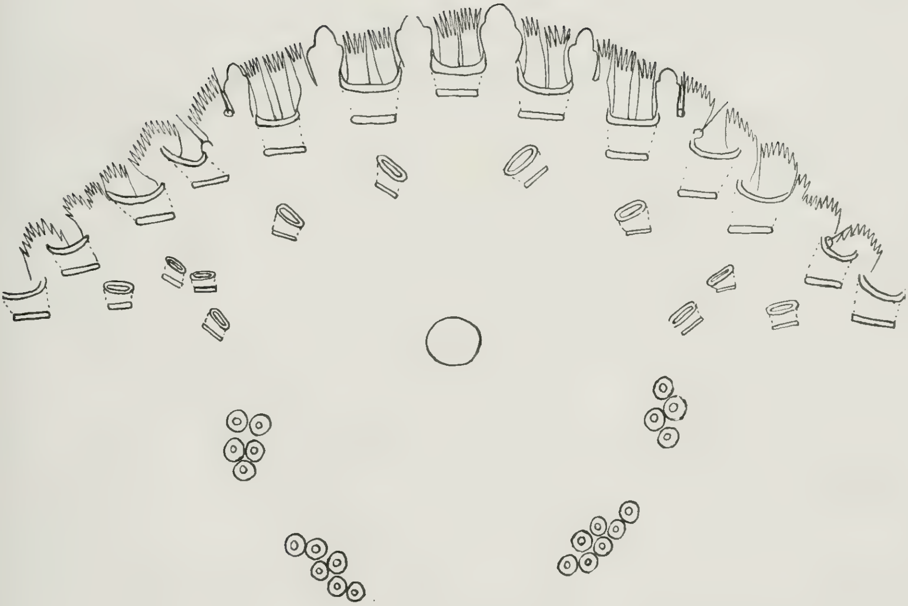


Fig. 2.

PLATE XXIX.

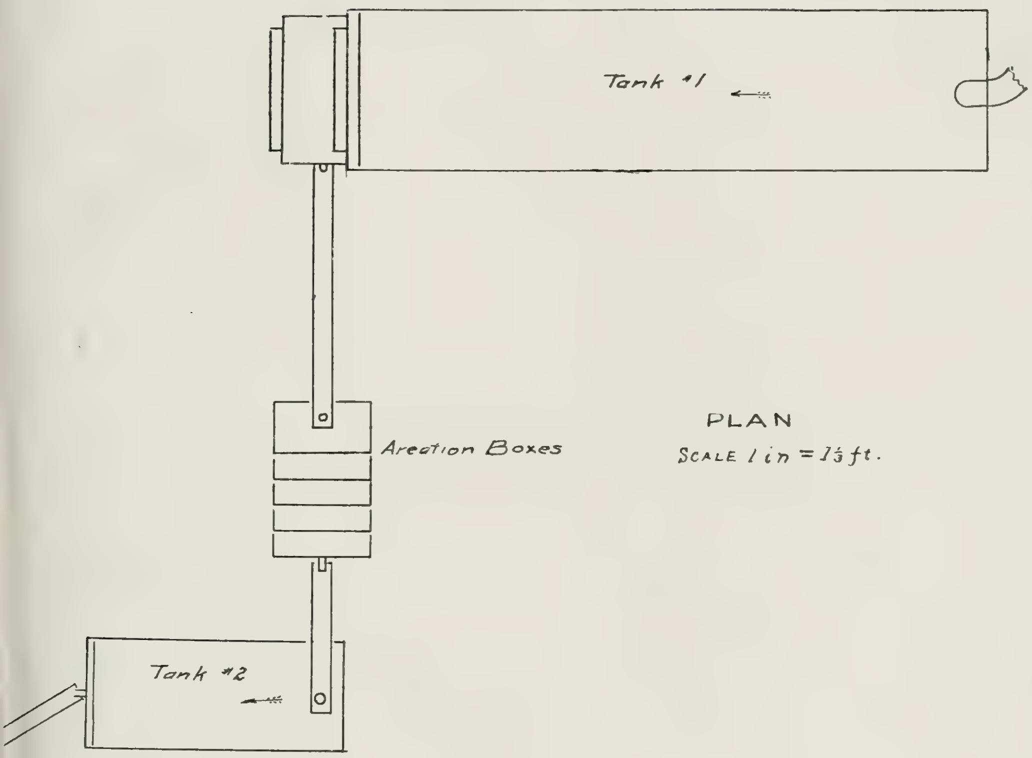
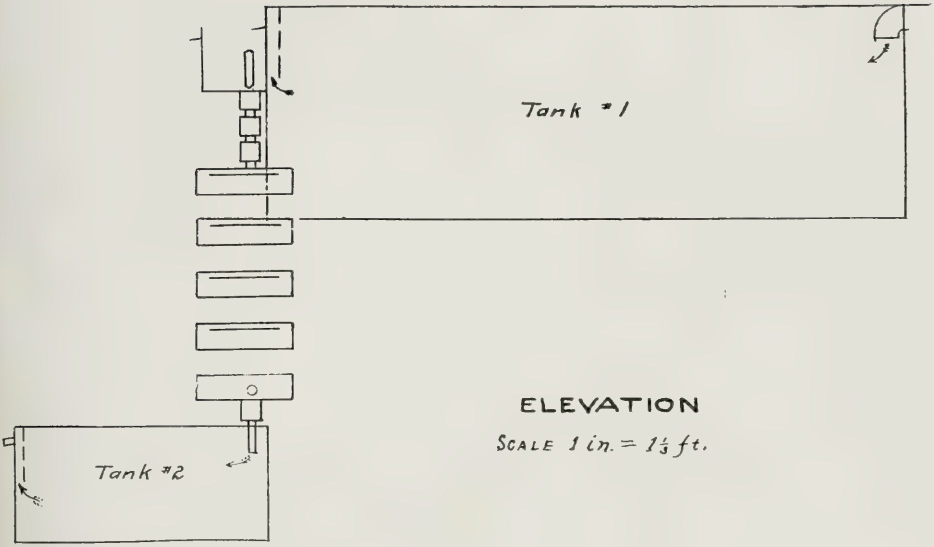

Tank #1
Areation Boxes
PLAN
SCALE 1 in = 1⅓ ft.
Tank #2

PLATE XXX.


Tank #1
Tank #2

ELEVATION

SCALE 1 in. = 1⅓ ft.

PLATE XXXI.

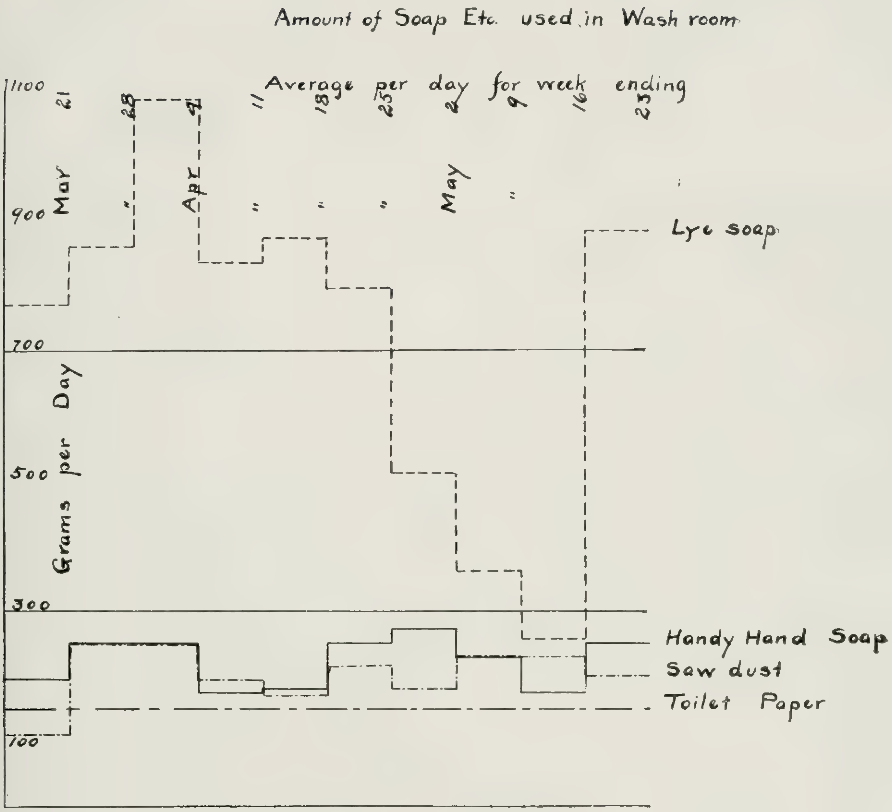

Amount of Soap Etc. used in Wash room
Average per day for week ending
Mar 21
" 28
Apr 4
" 11
" 18
" 25
May 2
" 9
16
23
1100
900
700
500
300
100
Grams per Day
Lye soap
Handy Hand Soap
Saw dust
Toilet Paper

PLATE XXXII.

Total Solids.

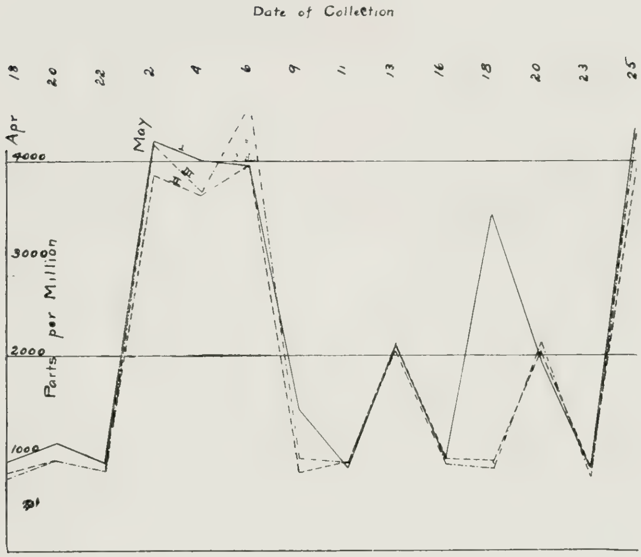


PLATE XXXIII.

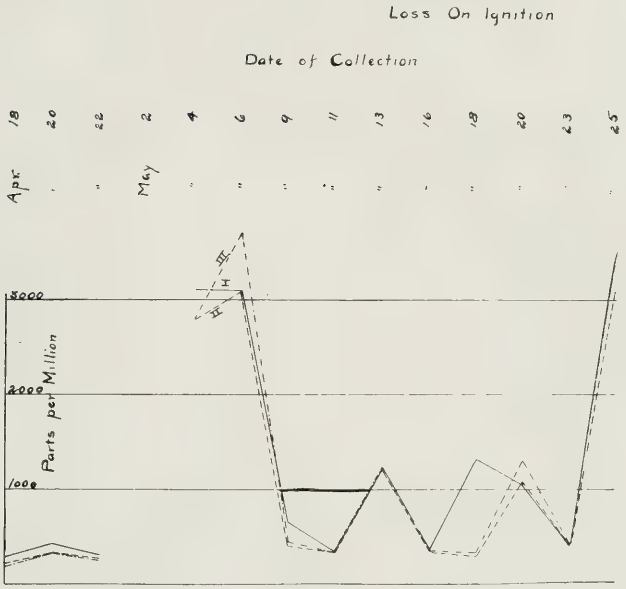


PLATE XXXIV.

Hardness

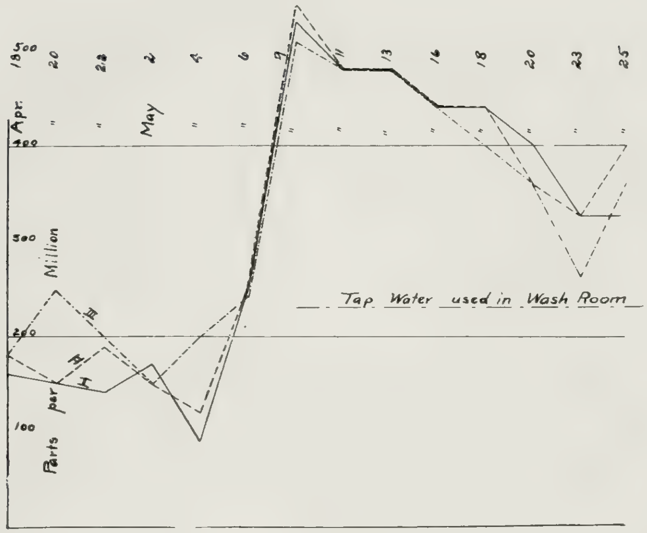


PLATE XXXV.

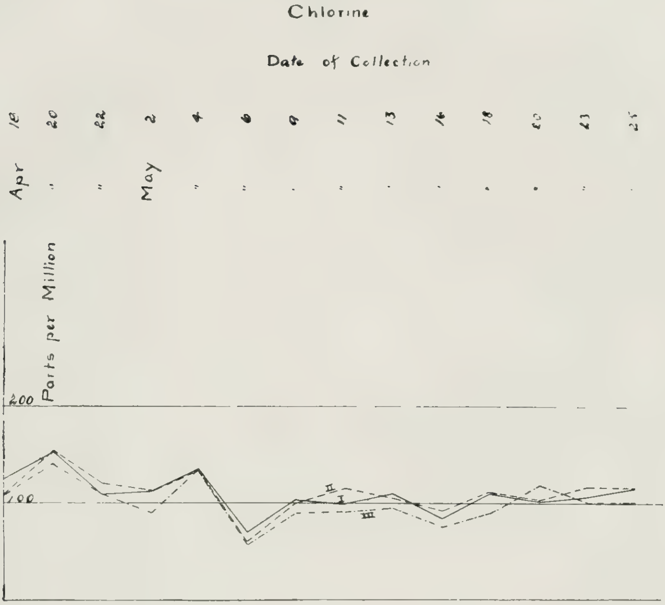
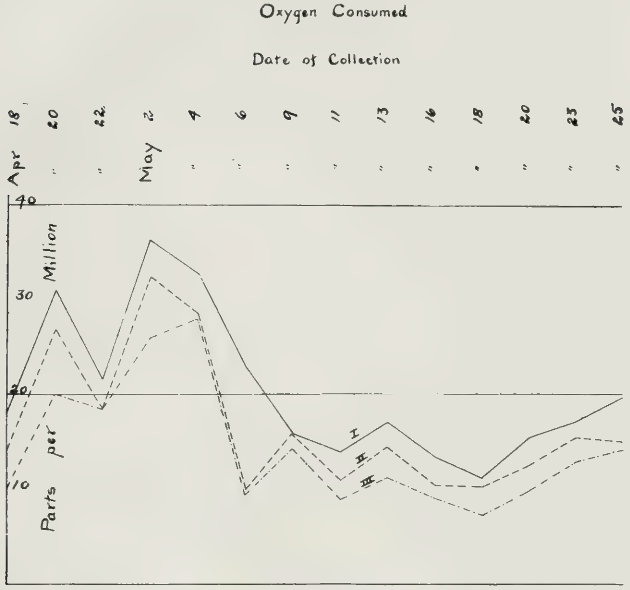

Chlorine
Date of Collection
Apr 18
" 20
" 22
May 2
" 4
" 6
" 9
" 11
" 13
" 16
" 18
" 20
" 23
" 25
Parts per Million
200
100
I
II
III

PLATE XXXVI.



Oxygen Consumed

PLATE XXXVII.

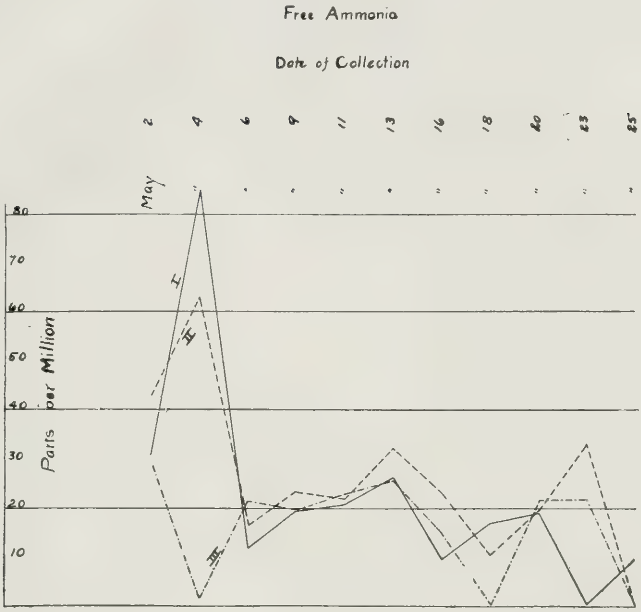


PLATE XXXVIII.

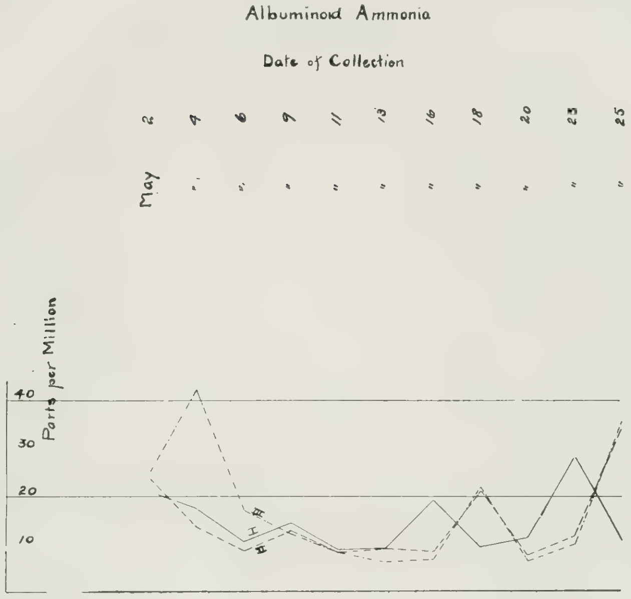


PLATE XXXIX.

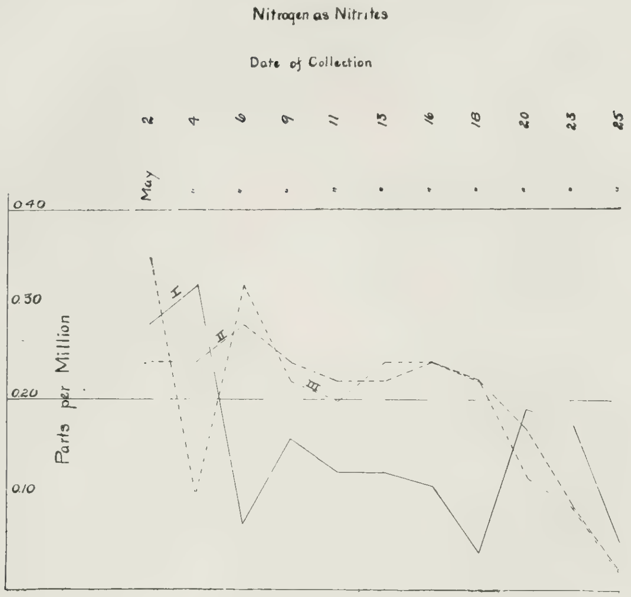

Nitrogen as Nitrites
Date of Collection
May
2
4
6
9
11
13
16
18
20
23
25
0.40
0.30
0.20
0.10
Parts per Million
I
II
III

PLATE XL.

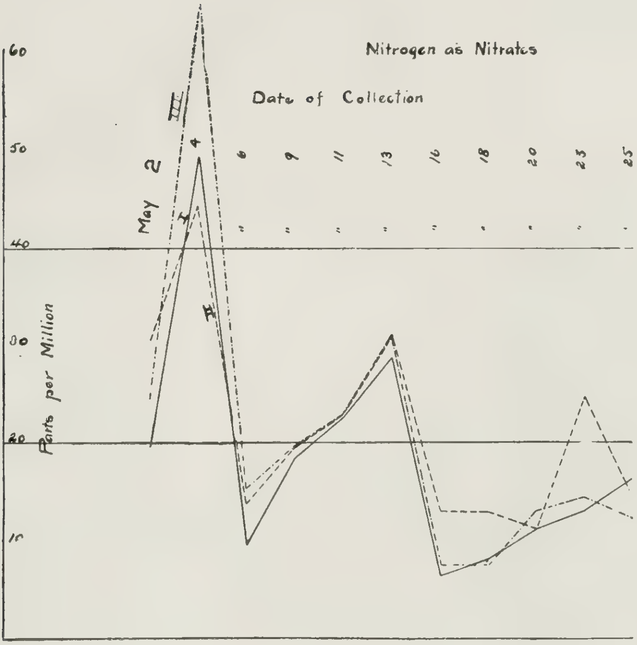

Nitrogen as Nitrates
Date of Collection
May 2
4
6
9
11
13
16
18
20
23
25
Parts per Million
60
50
40
30
20
10
I
II
III

PLATE XLI.

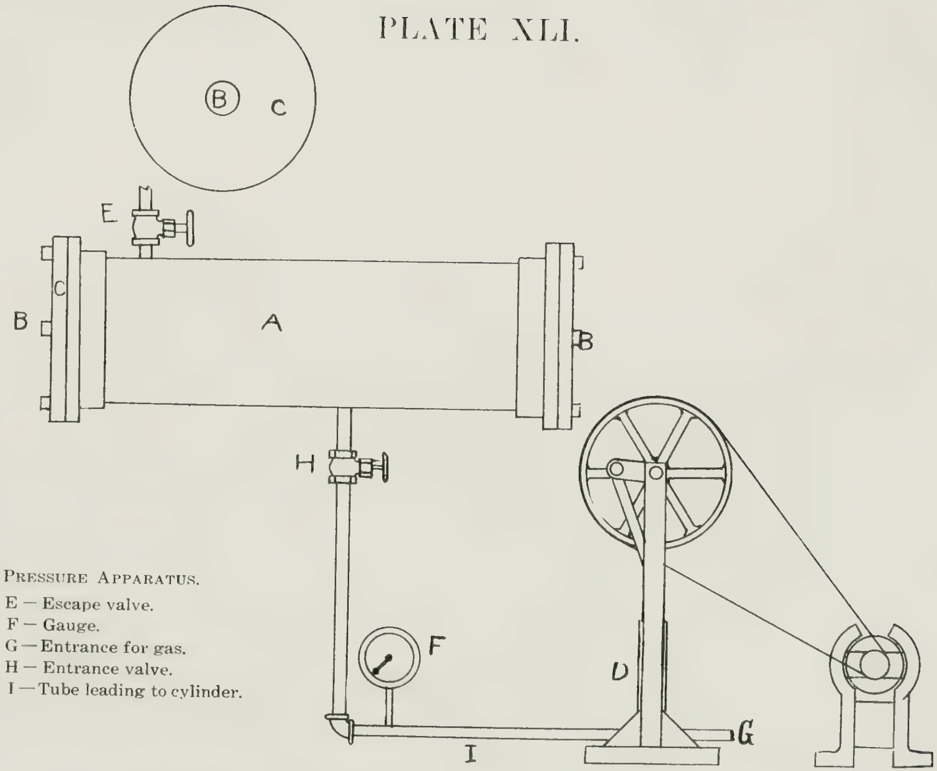


DIAGRAM OF THE PRESSURE APPARATUS.

A — Cylinder.
B — Glass window.
C — End cap.
D — Pump.
E — Escape valve.
F — Gauge.
G — Entrance for gas.
H — Entrance valve.
I — Tube leading to cylinder.

PLATE LXII.

Lampsilis recta, female, with shell structures indicated.

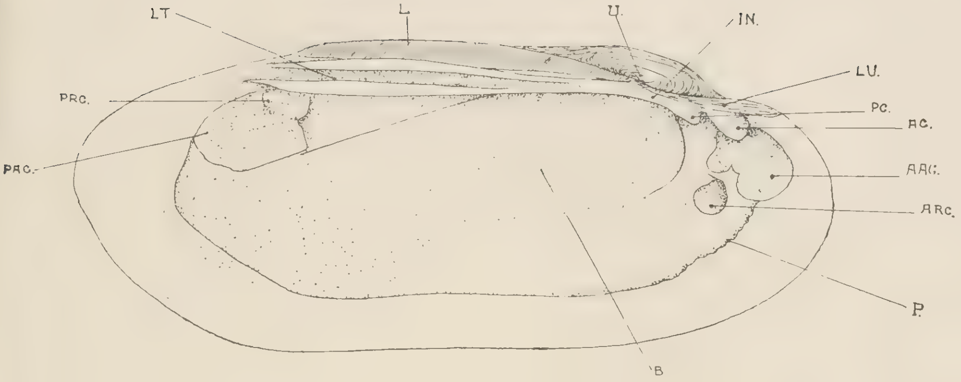
FIGURE 1.

AAC	Anterior adductor cicatrix or scar.
AC	Anterior pseudocardinal.
ARC	Anterior retractor cicatrix.
B	Branchial depression.
IN	Interdentum.
L	Ligament.
LT	Lateral teeth or laterals.
LU	Lunule.
P	Pallial line.
PAC	Posterior adductor cicatrix.
PC	Posterior pseudocardinal.
PRC	Posterior retractor cicatrix.
U	Umbone or beak.

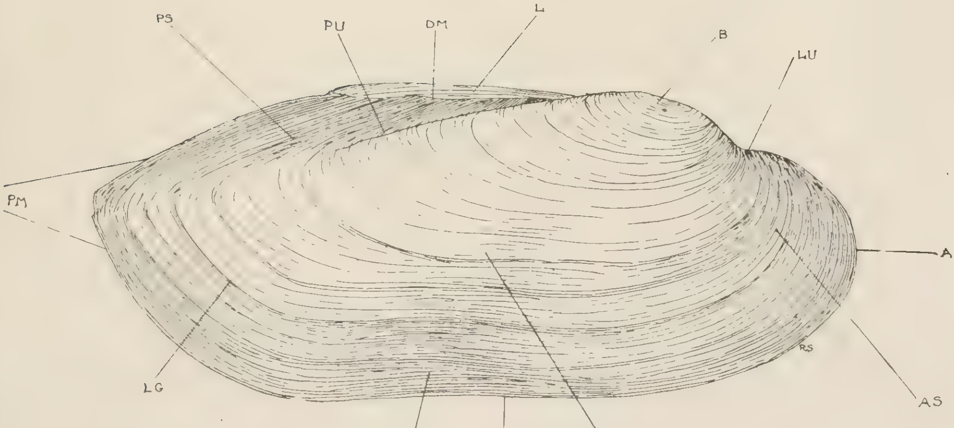
FIGURE 2.

A	Anterior margin.
AS	Anterior slope.
B	Beak or umbone.
DM	Dorsal margin.
L	Ligament.
LF	Lateral furrow.
LS	Lateral slope.
LU	Lunule.
PM	Posterior margin.
PS	Posterior slope.
PU	Posterior umboidal ridge.
V	Ventral margin.

PLATE LXII.


LT
L
U.
IN.
LU.
PRC.
PC.
AC.
PAC.
AAC.
ARC.
P.
B

1

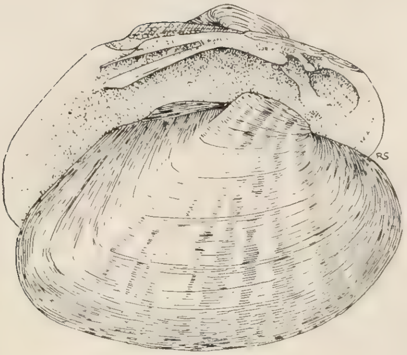

PS
PU
DM
L
B
LU
PM
A
RS
LG
AS
LF
V
LS

2

PLATE LXIII.

FIGURE 1.—*Truncillo triquetra.* ♂
FIGURE 2.—*Lampsilis ventricosa.* ♀

PLATE LXIII.



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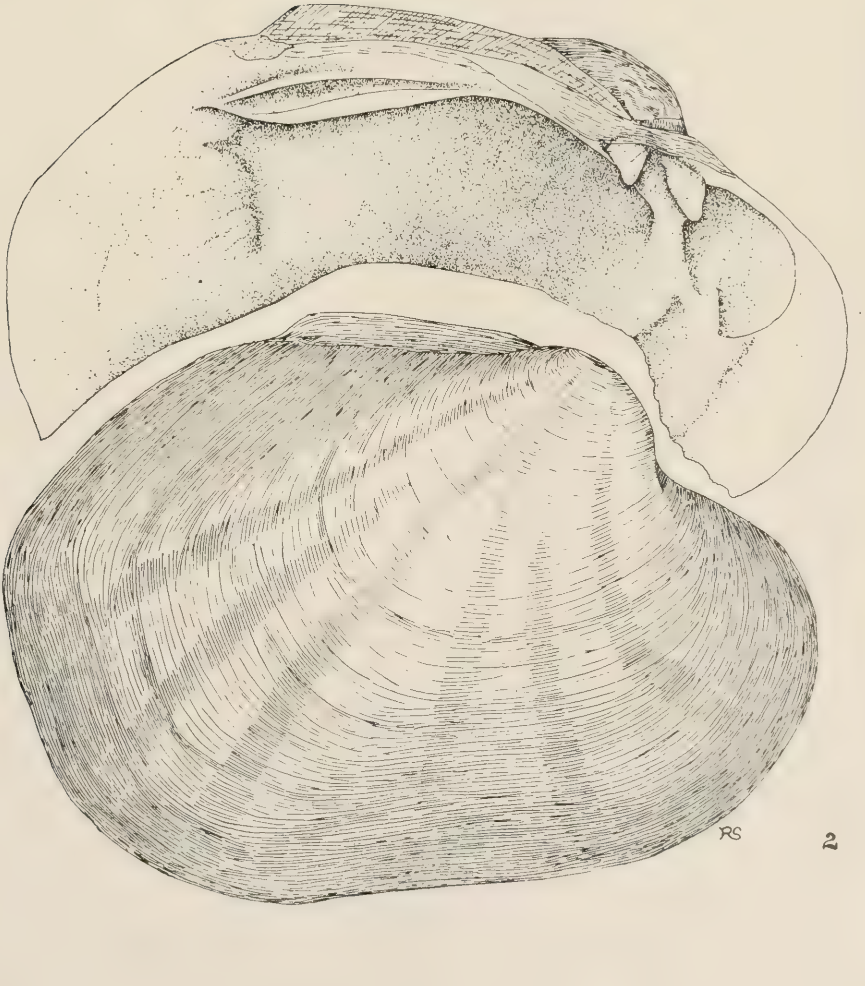
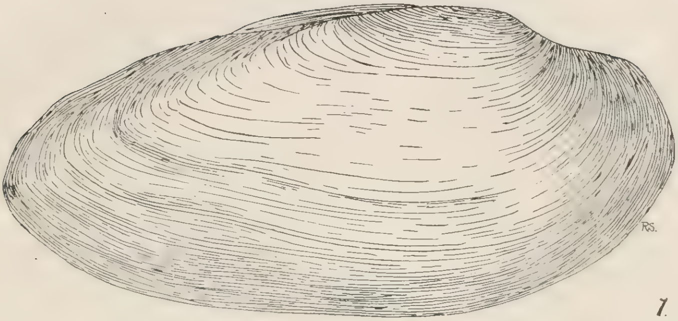


2

PLATE LXIV.

FIGURE 1.—*Lampsilis anodontoides.* ♂
FIGURE 2.—*Lampsilis luteola.* ♀

PLATE LXIV.



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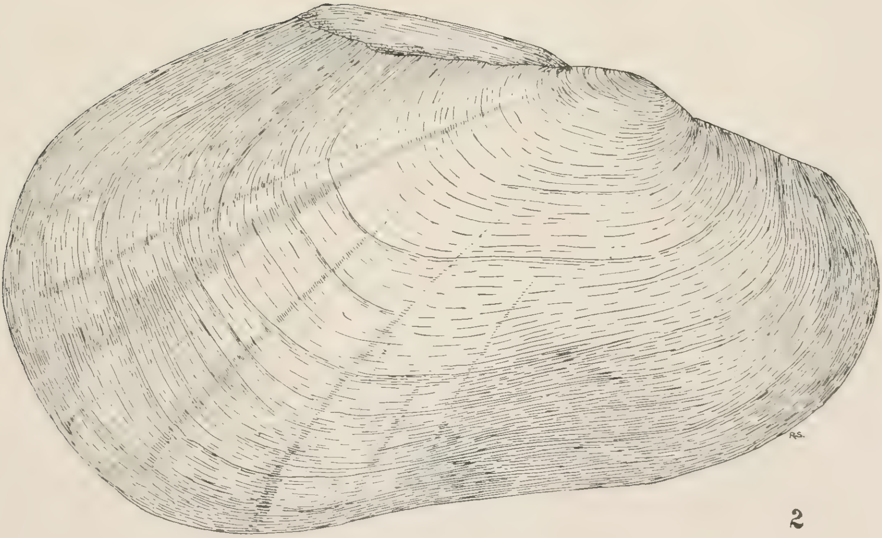


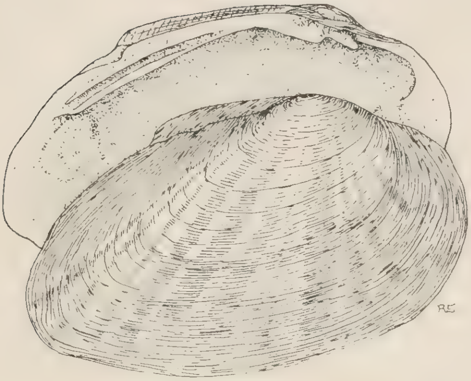
2

PLATE LXV.

FIGURE 1.—*Lampsilis ellipsiformis.* ♂

FIGURE 2.—*Lampsilis ligamentina.*

PLATE LXV.



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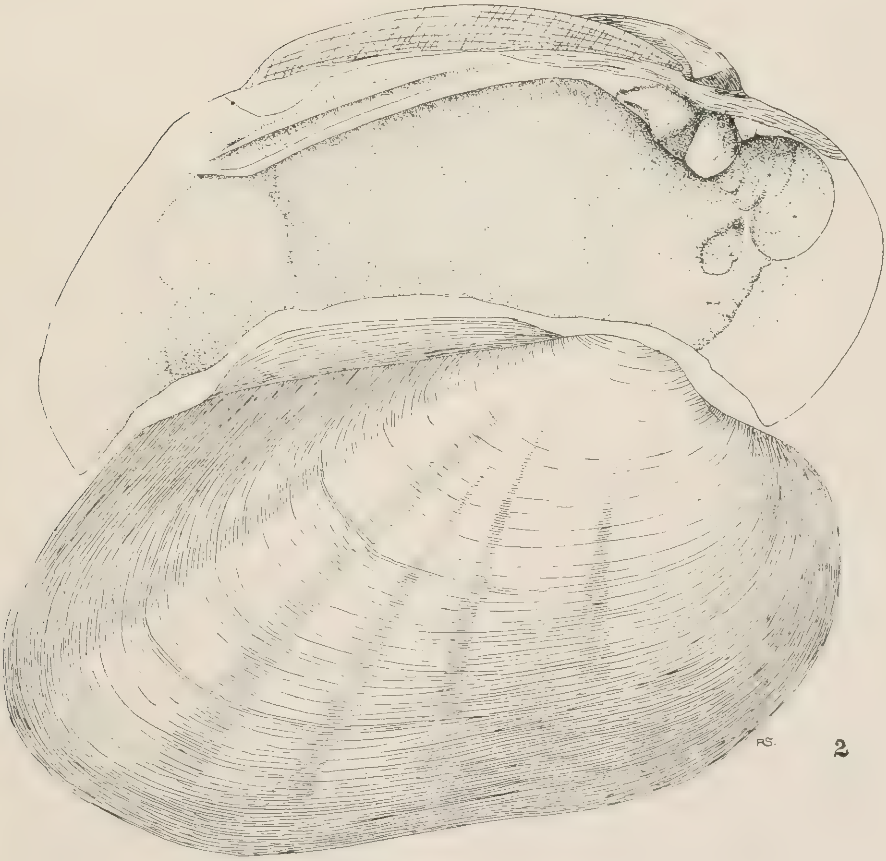


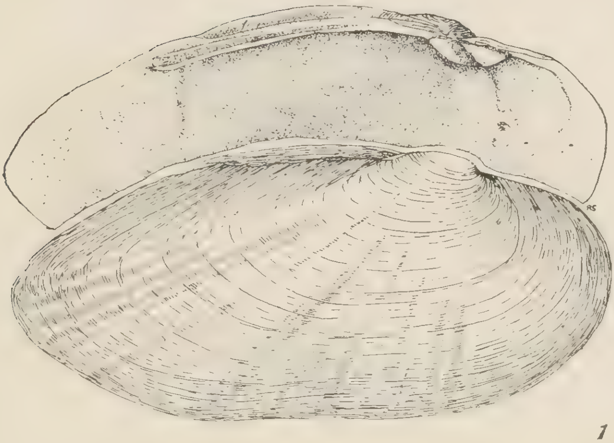
2

PLATE LXVI.

FIGURE 1.—*Lampsilis fallaciosa.* ♂

FIGURE 2.—*Lampsilis recta.* ♀

PLATE LXVI.



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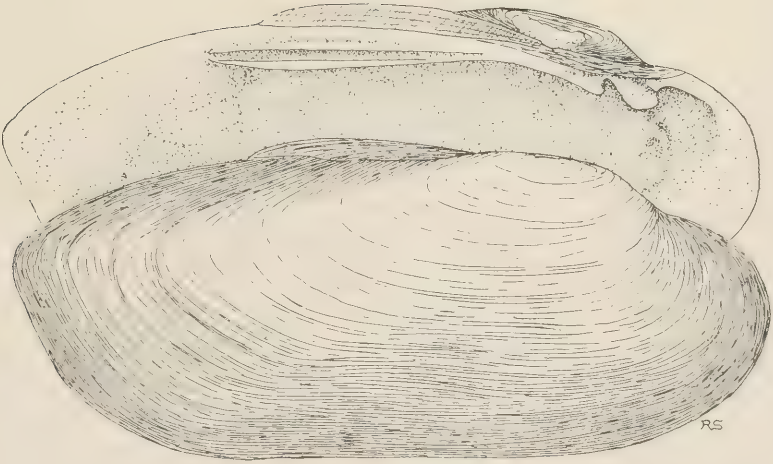
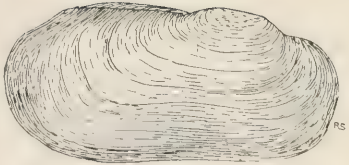


2

PLATE LXVII.

FIGURES 1 and 2.—*Lampsilis subrostrata.*
FIGURE 3.—*Lampsilis parva.*
FIGURE 4.—*Lampsilis gracilis* (juvenile).

PLATE LXVII.



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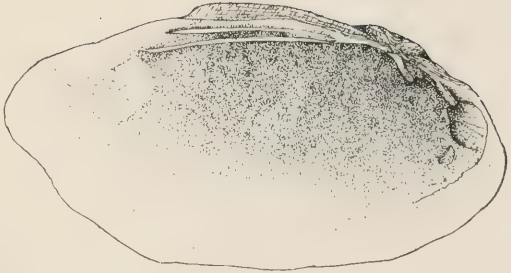

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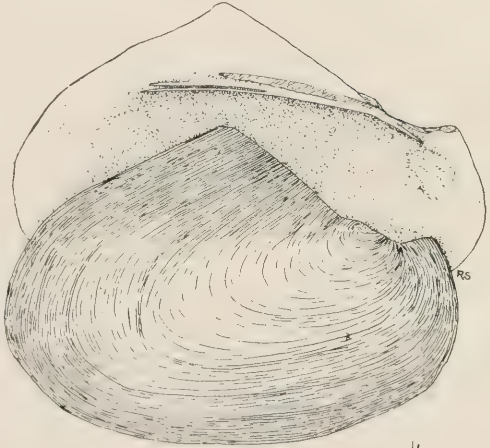

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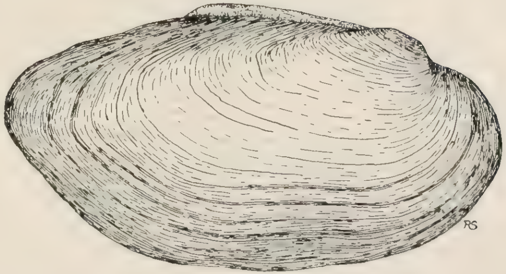

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PLATE LXVIII.

Lampsilis alata. ♂

PLATE LXVIII.

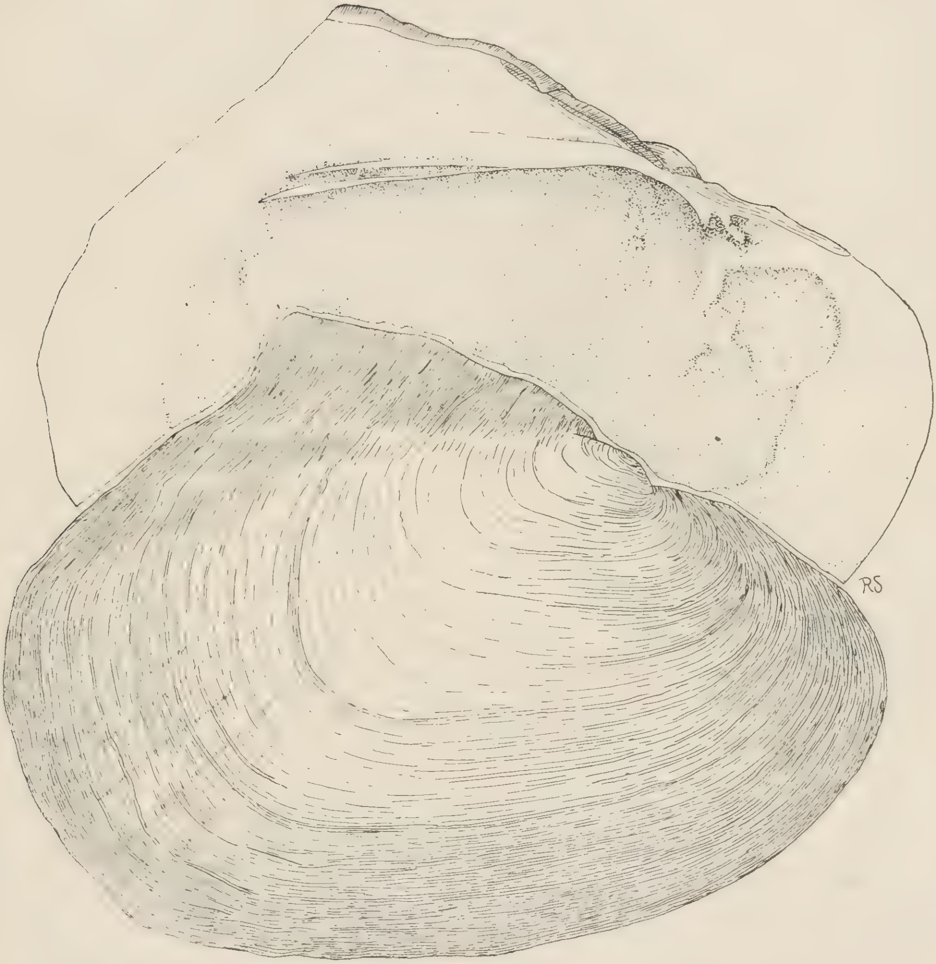
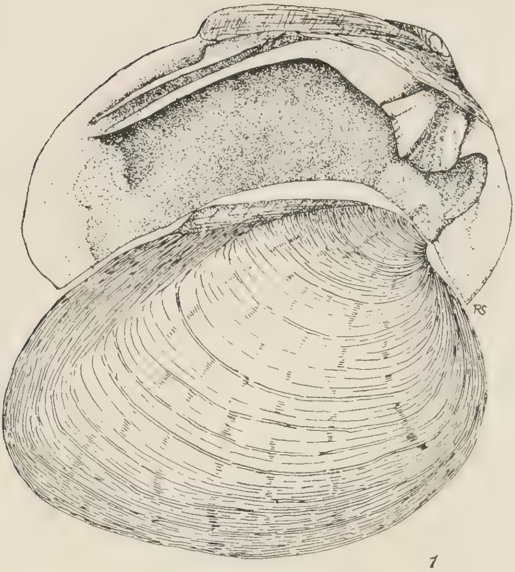


PLATE LXIX.

Figure 1.—*Plagiola securis.*
Figure 2.—*Obovaria ellipsilis.*

PLATE LXIX.



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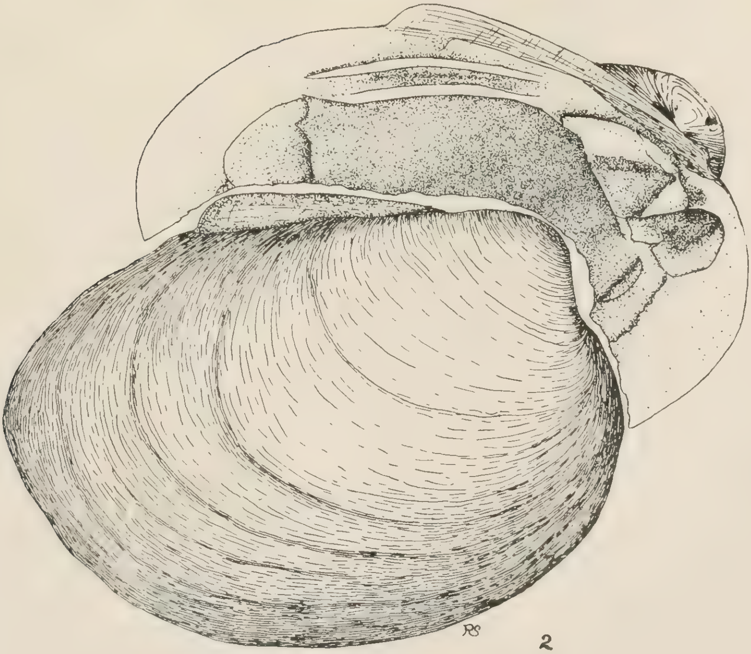
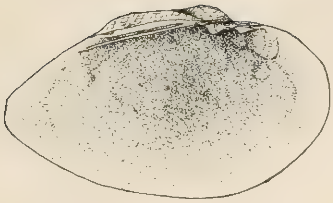


2

PLATE LXX.

FIGURES 1 and 2.—*Plagiola donaciformis.*
FIGURE 3.—*Plagiola elegans.*
FIGURE 4.—*Tritogonia tuberculata.* ♂

PLATE LXX.



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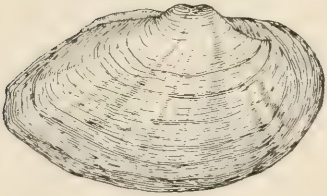

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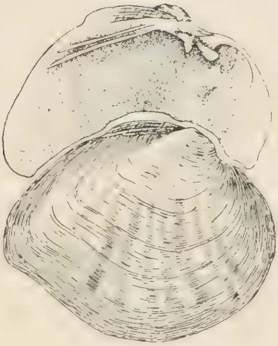

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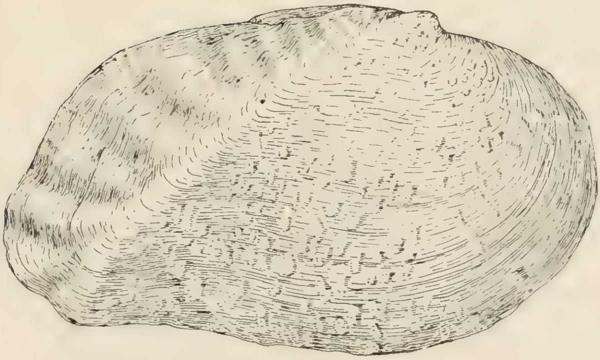
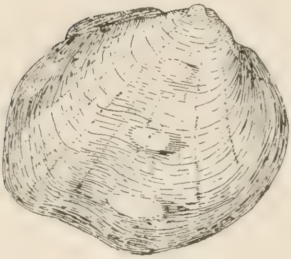


4

PLATE LXXI.

Figure 1.—*Obliquaria reflexa.*
Figure 2.—*Cyprogenia alberti.*

PLATE LXXI.



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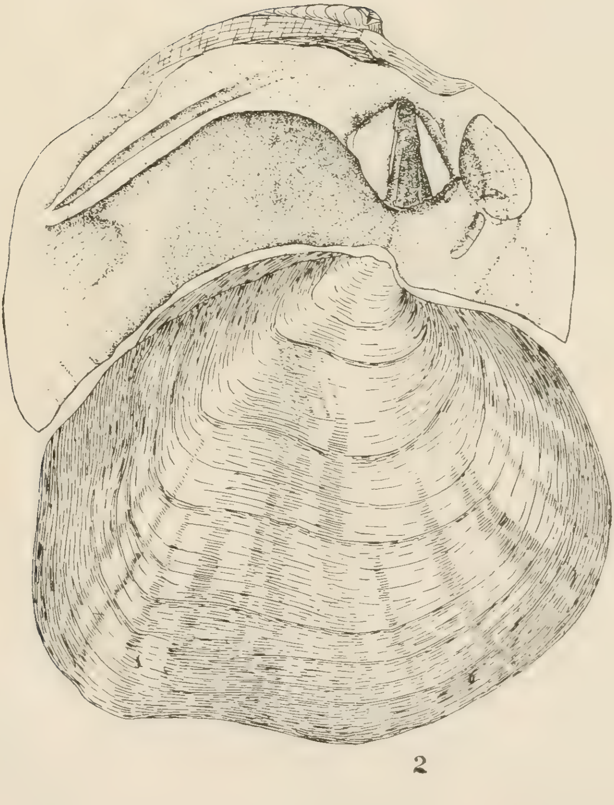

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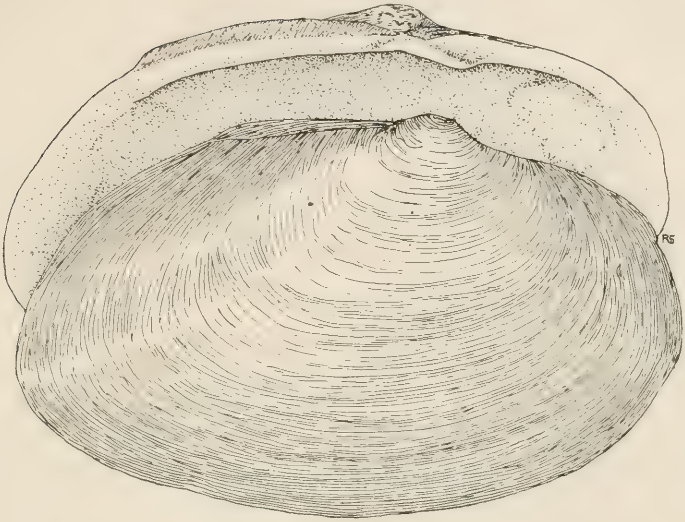
PLATE LXXII.

FIGURE 1.—*Strophitus edentulus.*
FIGURE 2.—*Ptychobranchus phaseolus.*

PLATE LXXII.



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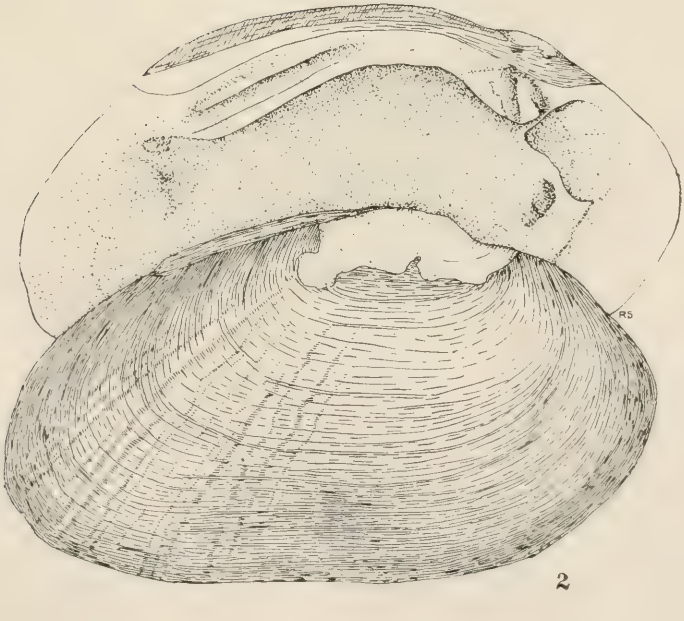

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PLATE LXXIII.

Anodonta suborbiculata.

PLATE LXXIII.

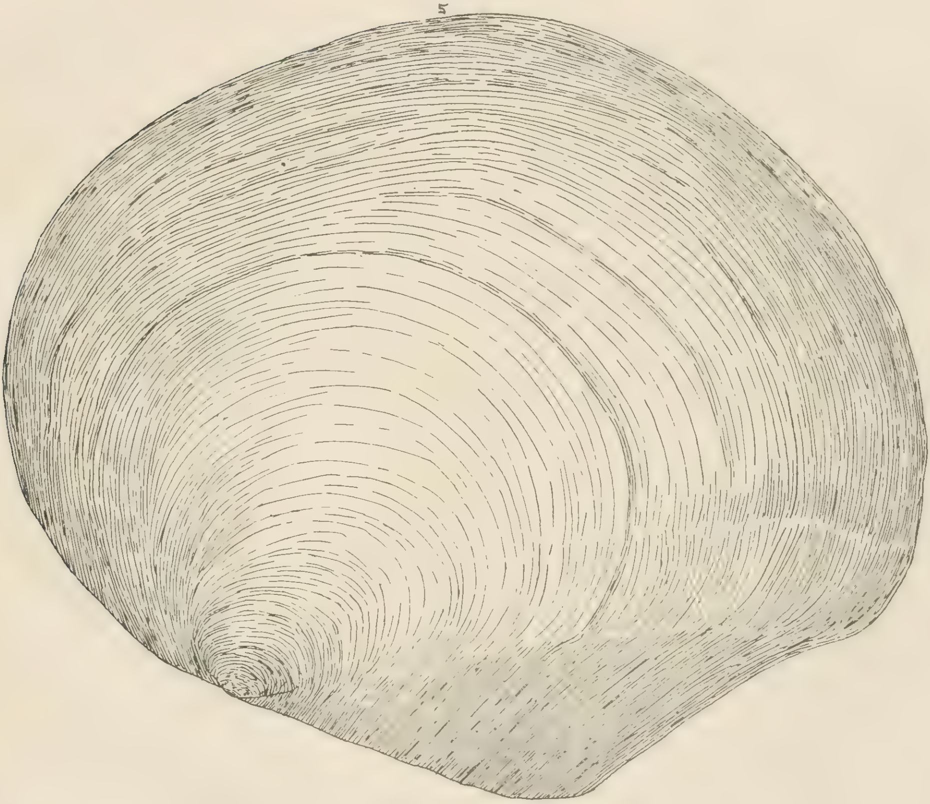
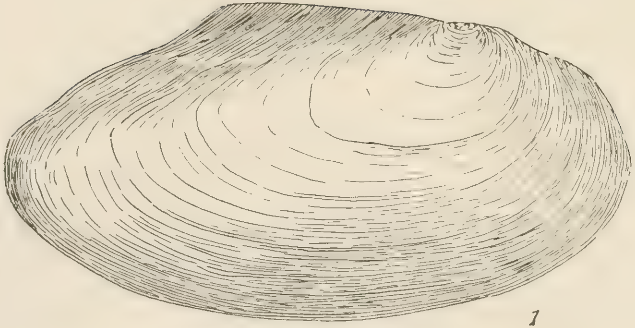


PLATE LXXIV.

FIGURE 1.—*Anodonta imbecillis.*
FIGURE 2.—*Anodontoides ferrussacianus.*
FIGURE 3.—*Anodonta grandis.*

PLATE LXXIV.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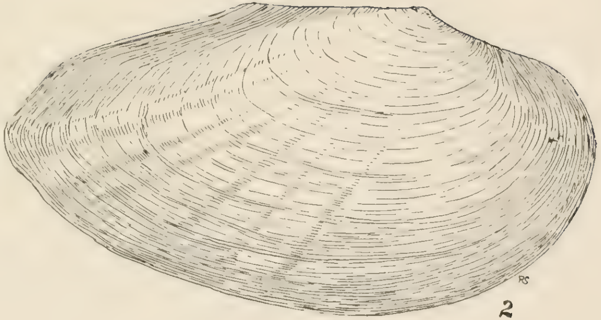

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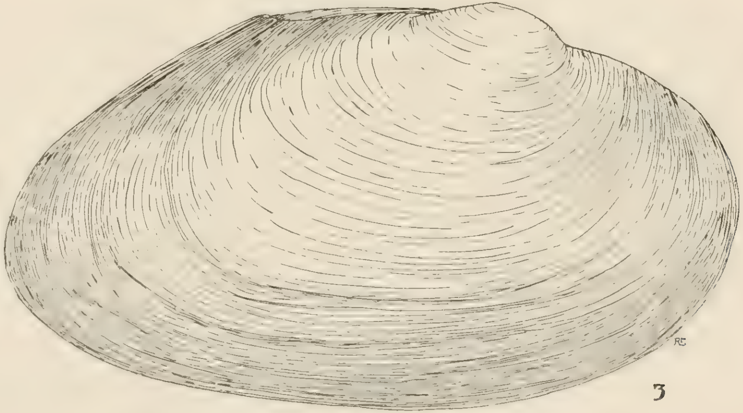

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PLATE LXXV.

Anodonta opaca.

PLATE LXXV.

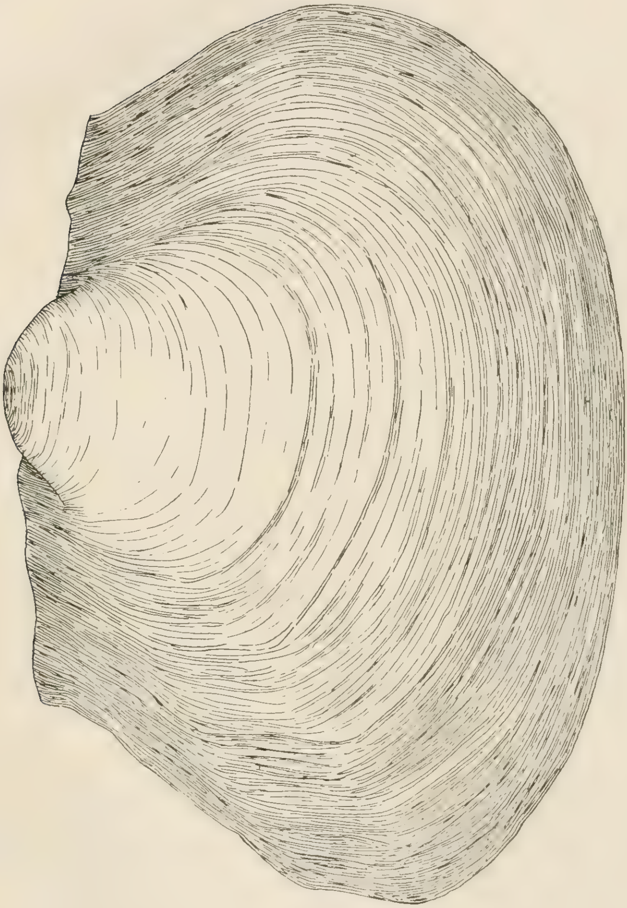
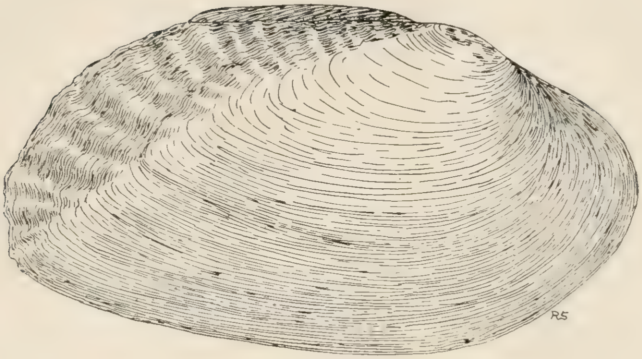


PLATE LXXVI.

FIGURE 1.—*Symphynota costa.*
FIGURE 2.—*Symphynota complanata.*

PLATE LXXVI.



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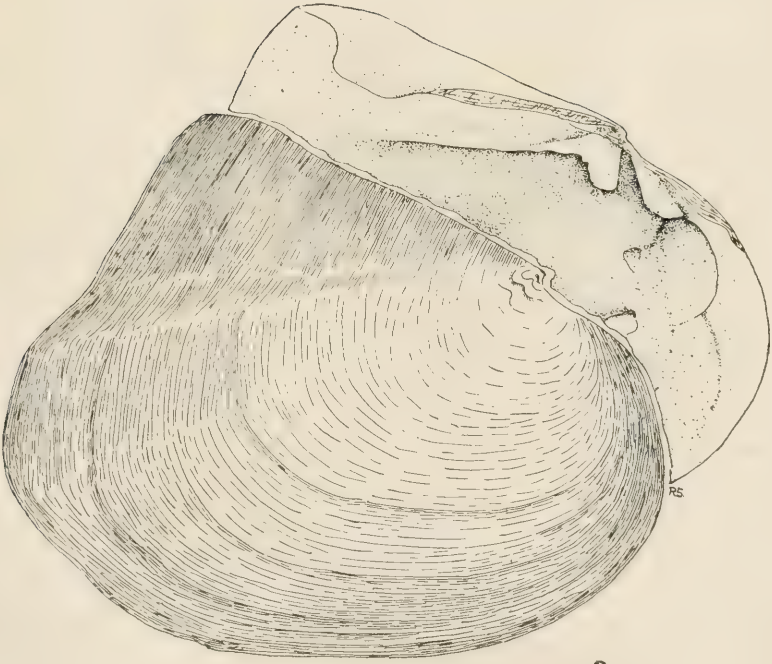


2

PLATE LXXVII.

Unio gibbosus.

PLATE LXXVII.

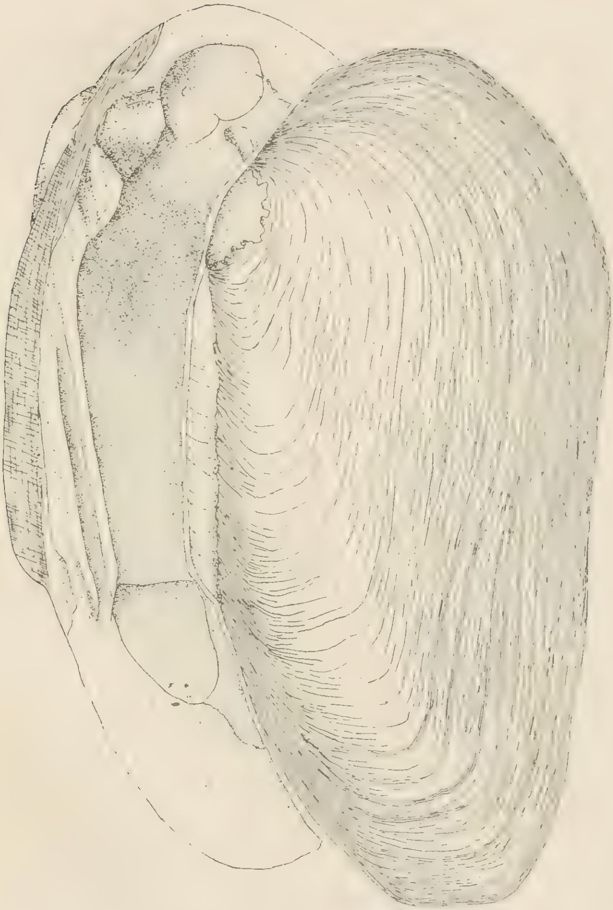
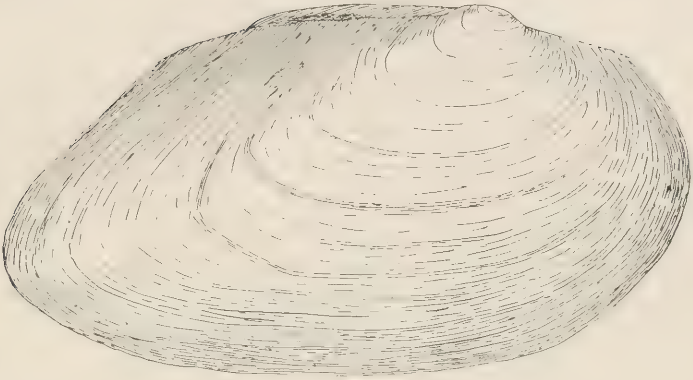


PLATE LXXVIII.

Figure 1.—*Unio tetralasmus.*
Figure 2.—*Pleurobema æsopus.*

PLATE LXXVIII.



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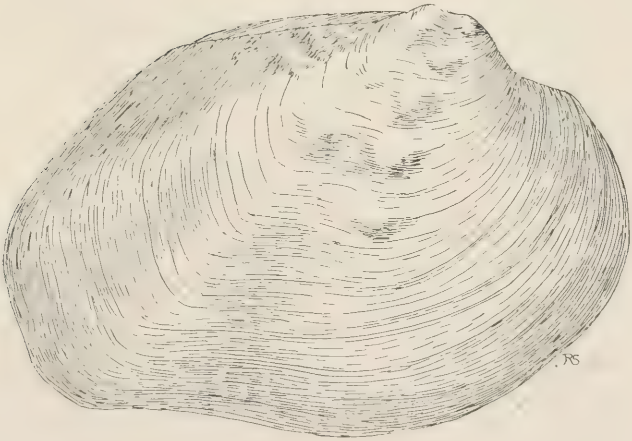

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PLATE LXXIX.

Quadrula plicata.

PLATE LXXIX.

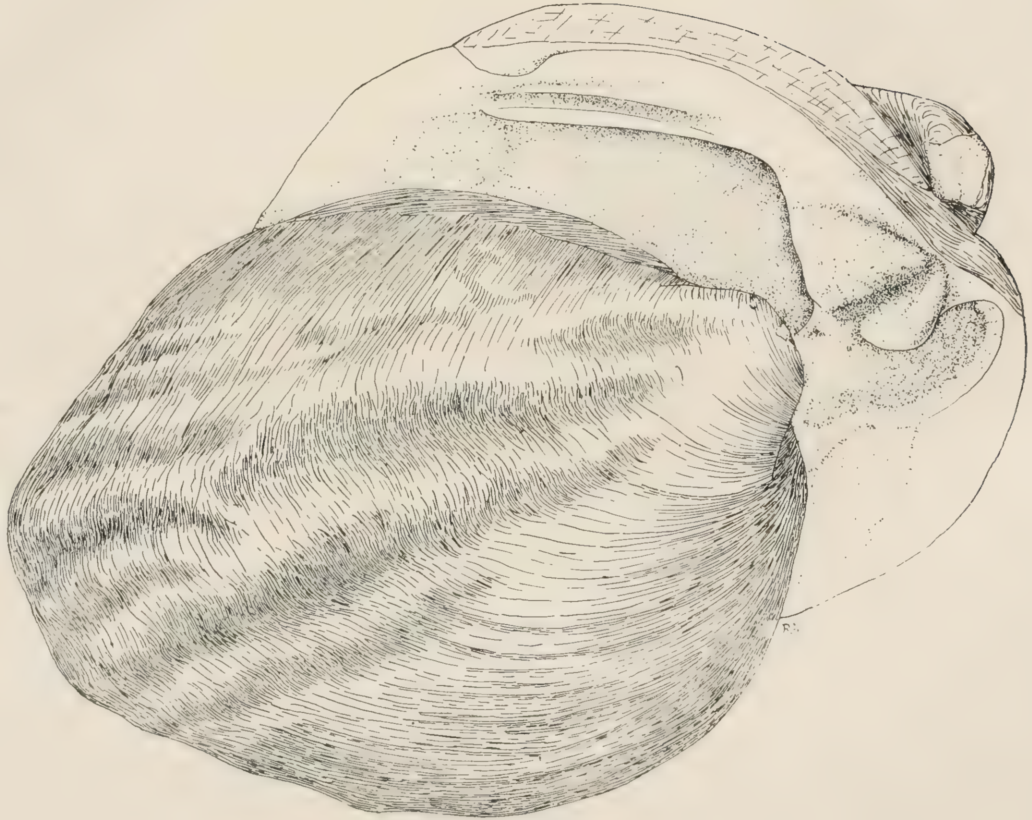
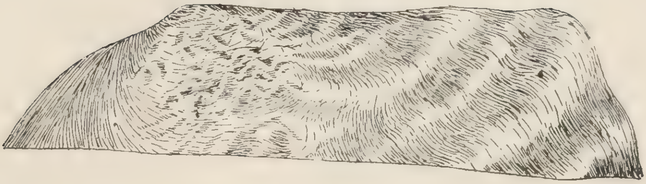


PLATE LXXX.

FIGURE 1.—*Quadrula heros.*
FIGURE 2.—*Quadrula undulata.*

PLATE LXXX.



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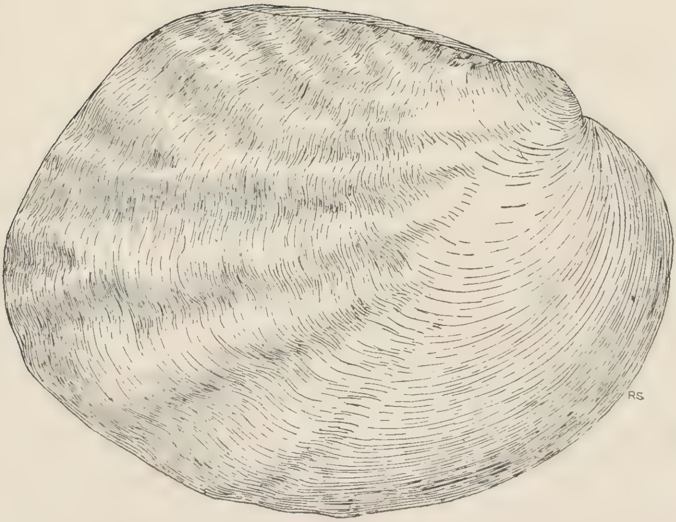

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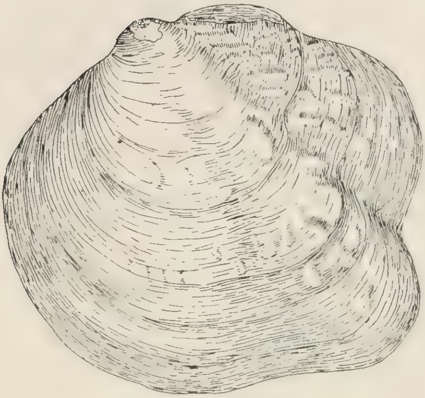
PLATE LXXXI.

FIGURE 1.—*Quadrula metenevra.*
FIGURE 2.—*Quadrula cylendrica.*

PLATE LXXXI.



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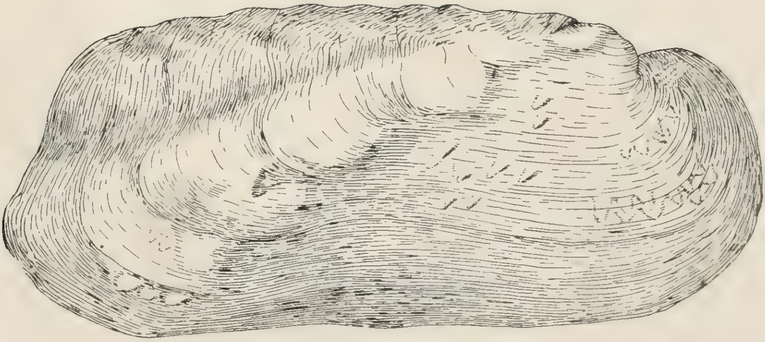

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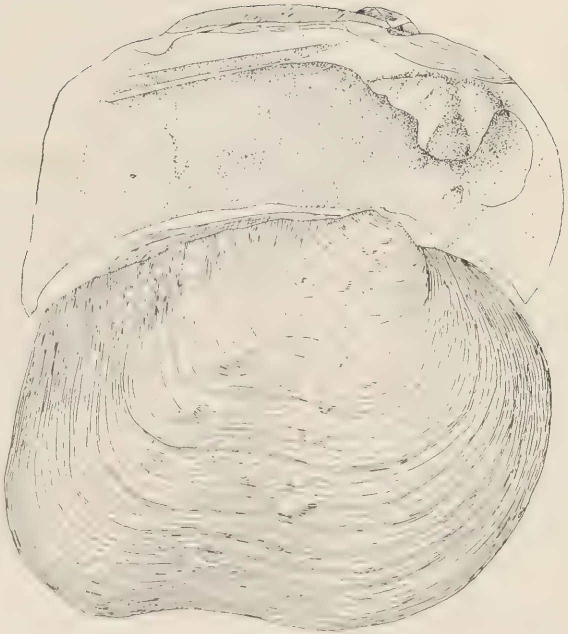
PLATE LXXXII.

FIGURE 1.—*Quadrula lachrymosa.*
FIGURE 2.—*Quadrula fragosa.*

PLATE LXXXII.



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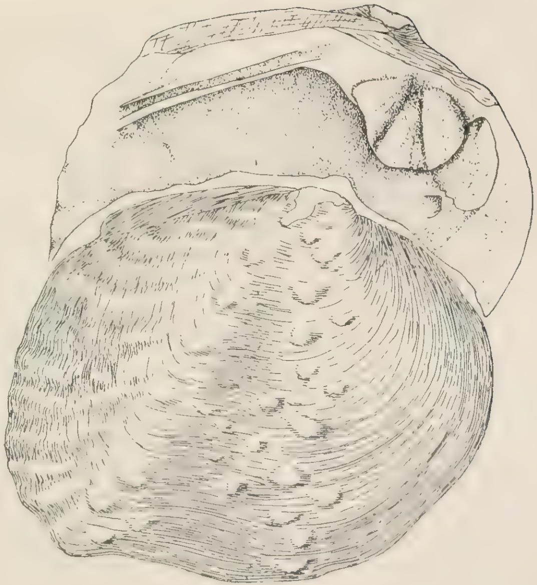

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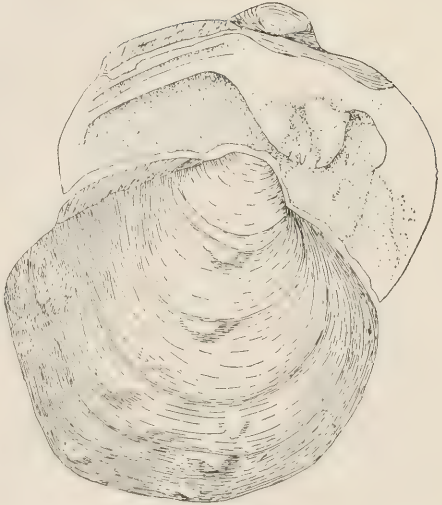
PLATE LXXXIII.

Figure 1.—*Quadrula postulata.*
Figure 2.—*Quadrula postulosa.*

PLATE LXXXIII.



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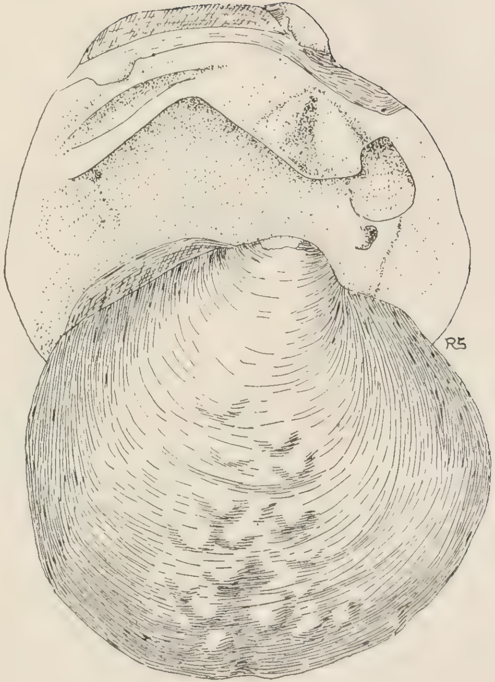

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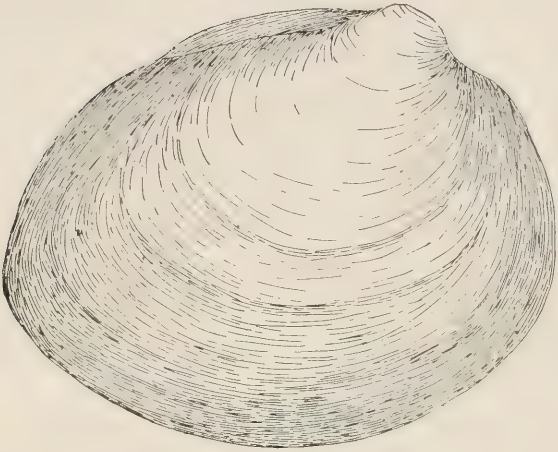
PLATE LXXXIV.

FIGURE 1.—*Quadrula coccinea.*
FIGURE 2.—*Quadrula rubiginosa.*

PLATE LXXXIV.



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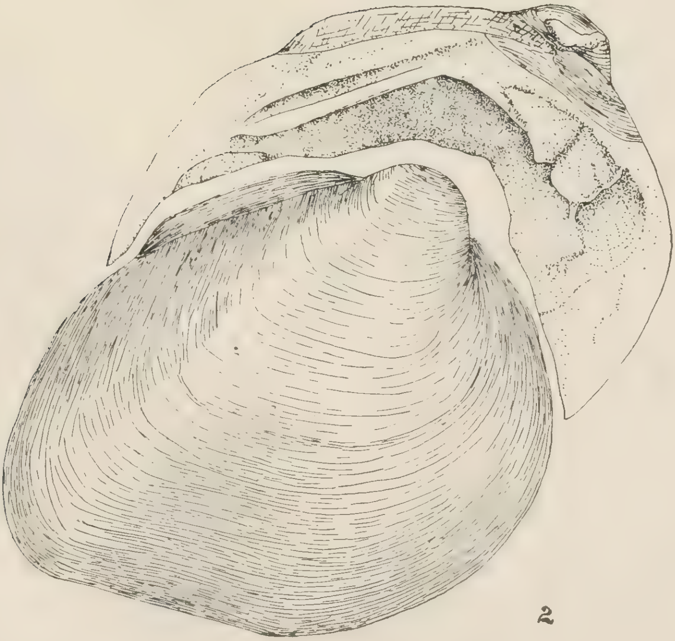

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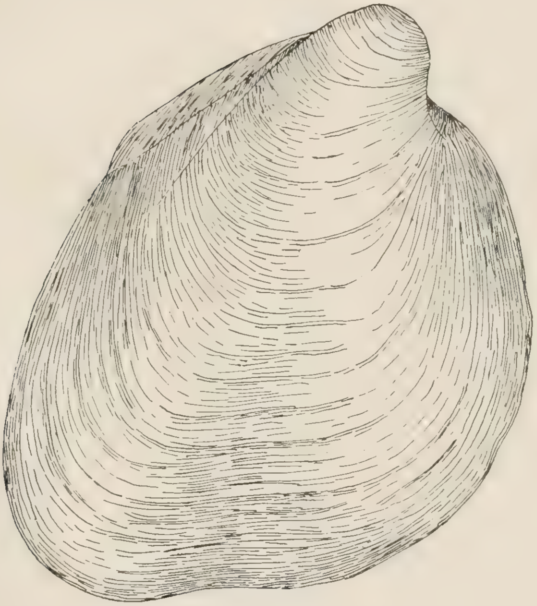
PLATE LXXXV.

Quadrula solida (juvenile).

PLATE LXXXV.



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